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TECHNICAL INSPECTION REPORT.

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U.S.S NEVADA (BB36).

TEST ABLE.

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(12) 153 p.

Director
Defense Atomic Support Agency
Washington, D. C. 20301

OPERATION CROSSROADS

DIRECTOR OF SHIP MATERIAL

JOINT TASK FORCE ONE

REG. NO. [redacted]

9795

193 6007

CONFIDENTIAL

BUREAU OF SHIPS GROUP

TECHNICAL INSPECTION REPORT

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Defense Atomic Support Agency
Washington, D. C. 20301

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APPROVED:

T. X. Forest,
Captain, U.S.N.

SECRET

USS NEVADA (BB36)

Page 1 of 153 Pages

GROUP-3
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1 JAN 1965

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TABLE OF CONTENTS

U.S.S. NEVADA (BB36)

SHIP CHARACTERISTICS

Building Yard: Fore River Shipbuilding Company.

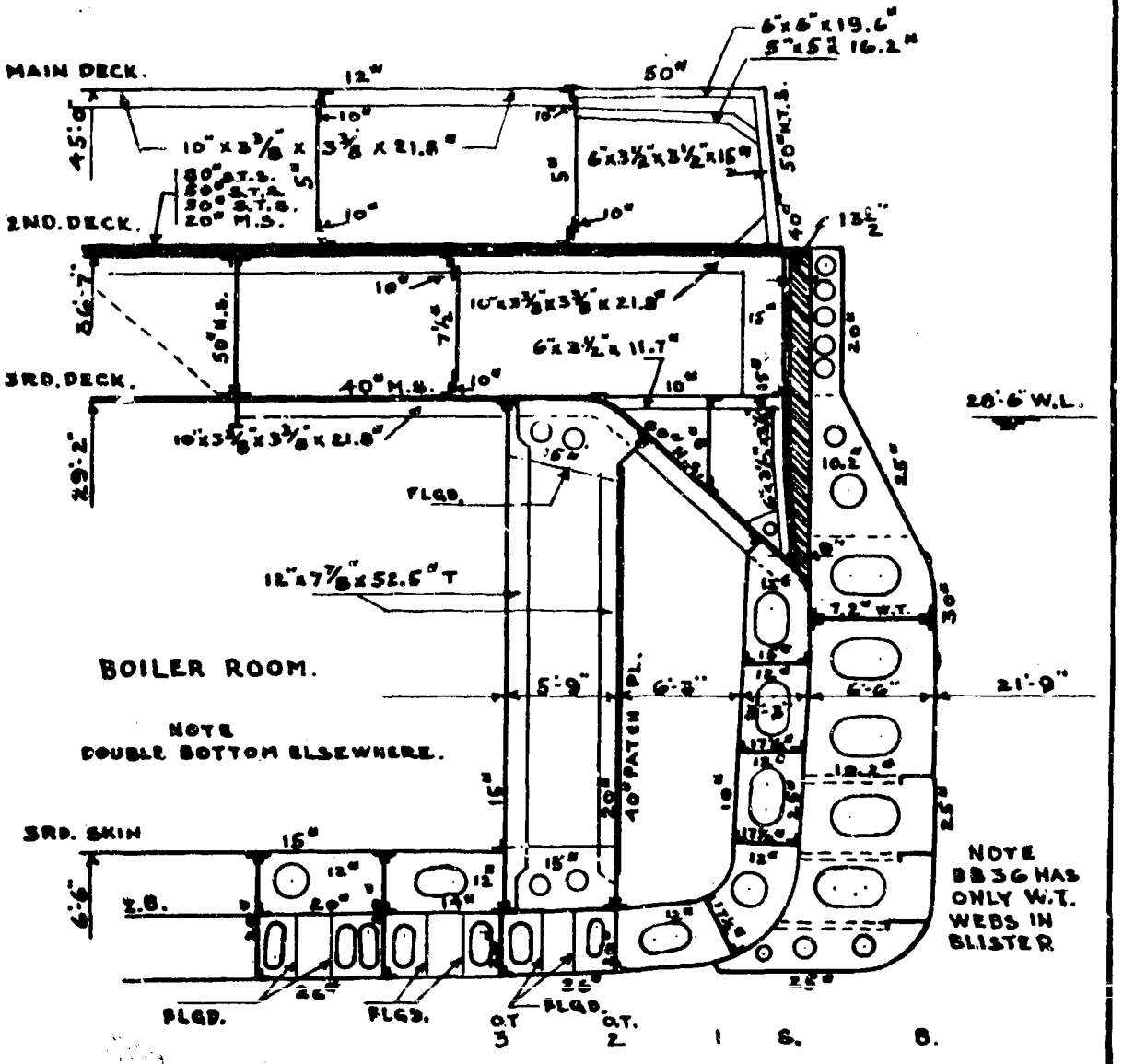
Commissioned: 11 March 1916

HULL

Length Overall: 583 feet 0 inches.
Length on Waterline: 575 feet 0 inches.
Beam (extreme): 108 feet 0 inches.
Depth (molded at side, to main deck, amidships): 44 feet 5 1/2 inches.
Drafts at time of test: Fwd. 28 feet 0 inches.
Aft. 32 feet 0 inches.
Standard displacement: 29,000 tons.
Displacement at time of test: 32,070 tons.

MAIN PROPULSION PLANT

Main Engines: Parsons turbines, one high pressure, low pressure, and astern turbine for each of the two shafts. Mfg'd by the New York Navy Yard. Steam press. 265 psi. gauge.
Reduction Gears: Two complete units installed, single reduction type.
Boilers: Six installed - Water tube express type, Mfg'd by Norfolk Navy Yard.
Shafting: Two installed - outside dia., 14", inside dia. 8".
Main Condensers: Two installed, cooling surface 14569 sq. ft. Mfg'd by Fore River Shipbuilding Corp'n.
Propellers; Two installed, blades Mfg'd by N. Y. Phil.
Turbo Generators: Four installed, 400 KW. Mfg'd by Westinghouse Electric Co., turbines by the Moore Steam Turbine Co.



MIDSHIP SECTION

TEST A

SECRET

U.S.S. NEVADA (BB-36)

9795

TECHNICAL INSPECTION REPORT

OVERALL SUMMARY

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

The draft readings taken just prior to, and immediately after the test are as follows:

	Forward	Aft	Mean	List
Before Test -	28' 0"	31' 0"	29' 6"	0 Degrees
After Test -	28' 0"	31' 0"	29' 6"	0 Degrees

Some seepage through the shell into four after voids in way of the skeg has occurred, but there was not enough water taken on to change the trim or draft.

(b) Structural damage.

HULL

Superstructure - The sides and after face of the superstructure are mildly dished, showing the almost undirectional effect of the blast. The critical plate weight appears to be about ten pounds, with an additional advantage in strength being indicated for curved surfaces rather than flat panel areas of identical weight.

Light operational gear exposed to the blast such as antennae poles, radar screens, flag bags, and searchlights are carried away. Both topmasts are down. Handrails and light bulwarks are intact but damaged, and overhanging structure on the port side is deflected upwards a small amount.

The upper deck, forward of the superstructure, is deflected between transverse bulkheads. Maximum deflections of four to six inches appear to starboard alongside of No. 1 turret. The deck beams

and supporting structure conform to the deflection of the deck and the deck beams are distorted in way of their connections to bulkheads and shell stiffeners. Stanchions and light bulkheads on the main and second decks, immediately below, are buckled slightly (See figure 1).

A rectangular section of the main deck, extending longitudinally between frames 86 and 91, port side, failed in two places. The longitudinal failure lines were 29 feet off the centerline and 13 feet off the centerline through a single riveted seam. The opening is approximately 20 feet long by 16 feet wide and is in way of machinery access plate. The failure appears to be attributable, primarily, to a lack of supporting stanchions.

There is heavy deflection of the main deck aft as a result of blast. The most severe depression is slightly aft of No. 4 turret (Figures 1 and 2). This depression pulled the deck away from the after face of No. 4 barbette. The maximum deflection in this area is about 16 1/2 inches. Between frames 122 and 132 the maximum deflection is about 14 inches. The deflections of the main deck are accompanied by failure of supporting stanchions and distortion of connections of the deck beams to the shell stiffeners. The second deck is deflected aft of the armor from bulkhead 122 to about frame 134, the maximum being about 12 inches. The damage diminishes as it goes deeper into the ship.

The plane handling crane on the stern is collapsed. The catapult foundation is tilted forward as a result of the deck deflection.

The interior space under the failure in the port side of the main deck, frames 85 to 96, is heavily damaged by blast. There is evidence of mild shock in the second deck spaces aft of No. 4 barbette, such as failure of cast iron motor foundations, separation of covers in ventilation ducts, and failure of piping support brackets in way of their welded connection to the overhead.

Below the armored second deck there appears to be no structural damage, except that resulting from a mild blast wave conducted through the ventilation systems. This is confined almost

entirely to the firerooms, where the boiler casings were ruptured.

The shell above the waterline is intact and appears to be in good condition, except for some panel dishing on the port and starboard quarter.

The exterior paint exposed to the blast is generally scorched and blistered through about one coat.

The only damage to the underwater body appears to be the seepage of water through the shell into four voids near the skeg.

MACHINERY

The outer casing of the stack was torn away at its base on the port side. The stack was dished in, especially on the port side, and was crushed in at the top. The inner casing of the stack and the upper part of the uptakes were badly crushed. Deflection of decks and bulkheads, especially collapse of the main deck soft patch, caused considerable damage to piping. Ventilation ducts to both enginerooms were severely damaged. The crane boom was twisted at its base and bent over to starboard but the crane machinery is operable.

ELECTRICAL

In the areas of structural damage the adjacent or attached electrical equipment was damaged by deformation of the supporting structure or by being struck by missiles. This occurred in the mast structures, on the second deck at frames 86 to 91 port, and aft of frame 126, port and starboard.

(c) Other Damage: Machinery, electrical, ship control, fire-control, gunnery, electronics.

HULL

The airplane crane training gear is inoperable. All boilers are out of commission, and the ventilation system of the port engine room is not functioning. The whistle and siren are demolished.

Electrical cables running through the burned areas of the upper deck, frames 70 to 85, are burned.

Fire control has been reduced to some extent due to damage to the director and the loss of all fire control and search radar antennae.

The C.I.C. and all transmitting and receiving radio and electronic equipment is reported as undamaged, except for the loss of all exposed antennae.

MACHINERY

All boiler casings failed, brickwork was moderately damaged. Damage to the stack partially closed the gas passages from the boilers. All forced draft blower suction flaps were bent and jammed closed. There was considerable local damage to piping, mostly caused by failure of deflection of supporting structures. The whistle and siren were knocked off and demolished. The crane was damaged structurally.

ELECTRICAL

The following electrical equipment received damage during this test:

1. Searchlights.
2. Running anchor and signal lights.
3. Magnesyn, and magnetic compasses.
4. Gyro repeaters and alidades.
5. Topside announcing system reproducers.

II. Forces Evidenced and Effects Noted.

(a) Heat.

HULL

The blast center appears to be about 210 degrees rela-

tive and at an approximate elevation of 45 degrees. The heat effect is not severe. Although on exposed surfaces, scorching is extensive, blistering is only moderate and extends not more than one coat down in 95% of the area affected. Nowhere does there appear to be more than two coats affected.

The wood covered weather decks are superficially scorched. Shell plating is scorched only on those surfaces facing the blast which composes practically all of the port side, stern, and a few frames of the starboard quarter. All exposed topside surfaces facing the blast are also scorched. In a few areas the scorching is heavier than average and nearby indirectly exposed surfaces are lightly scorched.

It is noted that the paint, covering wooden surfaces, is more heavily scorched than that covering steel surfaces under similar circumstances.

MACHINERY

Paint on exposed machinery was scorched and blistered. Otherwise there was no evidence of heat on machinery spaces.

ELECTRICAL

Radiant heat of the blast singed the topmast layers of paint on cables, wireways, and electrical equipment directly exposed to it, but failed to affect their electrical properties.

Several fires in Army Quartermaster supplies exposed on the 02 deck between frames 71 and 86 port and starboard burned through the wooden deck and overheated the cables in wireways on the 01 deck directly beneath it. The heat was sufficient to burn out a number of these cables which caused a loss of power to galley equipment.

(b) Fires and Explosions.

HULL

The bulkheads and overhead structures in the steam table space A-0114-L, frames 70 to 84, upper deck level and adjoining spaces are blackened, apparently as a result of ignition of grease in the galley ventilation system, due to the intense fire in U.S. Army Quartermaster gear stowed on the open deck above.

Several holes are burned in the teak wood cover of the upper deck forward of No. 2 turret. It is reported that small pieces of canvas and metal grommets were found within the burned areas. It is believed, therefore, that these fires were caused by the burning of a new, unpainted, canvas wind breaker on the forecastle which was ignited by direct heat radiation (figure 1).

Aft, on the starboard side, a three square foot section of the main deck cover at frame 144 is burned away. It is believed that this fire was a result of the ignition of a coiled 1/2 inch manila line by radiated heat.

The only large fire on board occurred in U.S. Army gear placed on the exposed superstructure deck between frames 70 and 80. Individual fires breaking out in packed army clothing and subsistence rations, port and starboard, nearly destroyed all of this equipment. Material stowed along the centerline, afforded protection from the effect of direct radiation by the after superstructure, is relatively undamaged. Some canned and boxed food evidently exploded, many cans and sections of boxed rations being over fifty feet away from their original positions. It is believed that ignition of these items was caused by radiated heat that penetrated into crevasses formed by the closely packed bales to a depth where the following air blast could not reduce the surface temperature below the kindling point by convection.

MACHINERY

Not evidenced.

ELECTRICAL

Fires in extremely combustible Army material exposed on the boat deck damaged lighting and power cables in the overhead of the compartment below, and destroyed phenolic type lighting fixtures, and connection boxes which were located in such a way as to receive

conducted heat through the overhead.

No evidence of explosions was noted.

(c) Shock.

HULL

There is practically no evidence of shock damage. On the second deck aft, below the depressed area of the weather deck, two cast iron intake blower motor housings have failed. Hangar straps are also broken loose from the overhead in a few instances. On these cases it is possible that the effect of the blast was transmitted rapidly to the immediate vicinity of these items through heavy stanchions added to support equipment stowed top-side.

MACHINERY

Some breakage of small piping was probably caused by shock. Leads left in the bearings of the port low pressure turbine indicate motion of the turbine journals not exceeding .007 inches.

ELECTRICAL

Although subjected to a large amount of pressure, very little acceleration was imparted to this vessel. Accordingly, there was little evidence of shock damage to electrical equipment on this vessel.

(d) Pressure.

HULL

All of the structural damage is considered to be a result of air blast. There is some evidence of "focusing" of the blast in athwartship passages in the superstructure. Topside compartments that were closed off show light panel dishing on all outer surfaces, apparently as a result of increased outside air pressure. The light outer casing of the stack is severely distorted. Doors and door frames show

considerable weakness where they are exposed to the blast. The weather deck is generally depressed, the after portion being dangerously weakened. The critical plate weight appears to be about ten pounds at this range.

The behavior of structure, which in this particular vessel is mostly outmoded (figures 4, 5, and 6), is of significance only to the extent that although directly exposed positions held up suprisingly well, and overall increase in designed strength of topside structure and the weather decks is necessary.

MACHINERY

Blast pressure caused nearly all damage to the machinery installation, either by its direct effect or by deflecting decks and bulkheads which in turn damaged piping, etc. This includes damage to the stack, boilers, crane, ventilation ducts and forced draft blower flaps. The pressure wave apparently came from near the port quarter.

ELECTRICAL

Blast pressure accounted for most of the damage to electrical equipment mounted topside. Starboard 36" searchlight was completely demolished by the blast, and the resulting fall to the boat deck. The port 36" searchlight was badly bent and its stand was torn from its foundations by the blast pressure. This damage resulted from failure of cast aluminum construction. Other evidence of damage by blast pressure was noted in the damage to alidades, announcing system reproducers, and other electrical equipment located in exposed places on the topside of this vessel.

(e) Effects peculiar to the Atom Bomb.

HULL

Subjection of the ship, almost simultaneously, first to rather intense radiated heat and then to high structural loading by air blast throughout the entire length of the ship are the only effects peculiar to the atomic bomb.

MACHINERY

A blast pressure of this magnitude at the range of the NEVADA from the explosion is apparently peculiar to the Atom Bomb.

ELECTRICAL

A radiant heat flash, quickly followed by an extremely powerful, and relatively slow acting blast wave are characteristic of this weapon.

III. Results of Damage.

(a) Effect on machinery, electrical, and ship control.

HULL

Propulsion was lost temporarily due to damage to boilers. Damage to considerable electronic gear is associated with the failure of topmasts, yardarms, and light superstructure plating.

MACHINERY

All steam power was lost by damage to boilers and stacks. Damage to ventilation ducts would have made the port engine room and possibly the starboard engine room untenable. It is estimated that temporary repairs to boilers and ventilation ducts to enable the ship to steam at slow speed could have been made by the ship's force within 48 hours. It is estimated that approximately 20 day's work at a shipyard would be required to restore the machinery installation to normal operation. The crane is inoperable because of structural damage. Damage to piping was of purely local significance and would have had little, if any, effect on any important system. Except for reduction of power available, the test had little effect on ship control as far as machinery is concerned.

ELECTRICAL

There was no effect on propulsion and electrical ship control equipment as a result of electrical damage to this vessel.

(b) Effect on gunnery and fire control.

HULL

Although there is little damage to exposed gun mounts, it is quite evident that the present bulwarks and splinter shields do not offer any appreciable protection from this type of weapon. However, completely enclosed mounts, even of relatively light weight, are undamaged and in good condition.

MACHINERY

No comment.

ELECTRICAL

There was only minor damage to gunnery or fire control circuits, except the damage to cables in the galley area by heat from fires on the deck above, which put the AA directors in that area out of commission.

(c) Effect on watertight integrity and stability.

HULL

There is no appreciable effect on stability. The watertight integrity is impaired above the second deck aft, of the bulkhead 115, by the separation of the weather deck from the after face of No. 4 barbette, and above the third deck, aft of bulkhead 122, by the centerline separation in the second deck resulting from the punching action of misaligned stanchions. There is also a large hole in the main deck, portside just aft of the break in the weather deck which has exposed the second deck between bulkheads 85 and 97.

MACHINERY

No comment.

ELECTRICAL

Damage to electrical equipment did not affect watertight integrity or stability.

(d) Effect on personnel and habitability.

HULL

It is evident that the casualty rate among exposed personnel would have been heavy. There is a slight reduction of habitability in crew's spaces on the second deck between bulkheads 85 and 97, and aft of bulkhead 115. The bakery and galley were unusable for a short period due to electrical failures and minor damage caused by fire in way of these spaces.

MACHINERY

It is estimated that casualties among fireroom personnel would have been high if the boilers had been steaming. It is not believed that there would have been any other casualties among personnel below decks.

ELECTRICAL

Damage to the galley area reduced the habitability for a period of about 3 days, until emergency circuits could be run to the bake shop and galley equipment. Ventilation sets suffered minor damage. No other electrical damage had any effect on the habitability of the vessel.

(e) Total effect on fighting efficiency.

HULL

The strength of the hull girder is but slightly impaired. The greatest effect on fighting efficiency, is the loss of power through damage to all boilers and the destruction of all electronic antennae, incident to the failure of masts. The amount of reduction in efficiency due to the high casualty rate among specially trained personnel because of inadequate protection from radiation and air shock, although unpredictable, appears to be of significance.

MACHINERY

The ship was temporarily immobilized. She could probably have been gotten underway at slow speed within 48 hours.

ELECTRICAL

The electrical damage reduced the fighting efficiency only by the loss of searchlights, certain fire control equipment, and reduction of telephone communications to the heavy machine gun control amidships.

IV. General Summary of Observers' Impressions and Conclusions.

HULL

Although the ship is in sound condition, structurally, protection against radiation and blast is inadequate. The destruction of masts supporting fire control, communications antennae, and venting of the blast into firerooms through the stack would have left the ship dead in the water and without adequate means of communication. Considering the time required to rig emergency repairs, this damage is believed to be critical.

MACHINERY

It is not believed that boilers of a modern battleship would have been damaged severely enough by this test to immobilize the vessel. Damage to the stack of a modern battleship would probably have caused some reduction in steaming capacity.

ELECTRICAL

Electrical damage to this vessel resulted from the effects of blast on masts, superstructure, and the main deck. This involved searchlights, fire control and communication equipment topside; vent blowers on the second deck; and cable runs in the galley area, and pinched or broken cable runs in the vicinity of structural damage in the maindeck aft of frame 90. No electrical damage occurred within the

armored box of the hull. Some of the blast damage would have been eliminated by the changes in design which has already been made in modern equipment. Cast aluminum bases, stands and searchlights, pelorus stands, and similar equipment were particularly susceptible to the damage by blast pressure, and provided examples of obsolete design which now have been proved to be inadequate. The damage by fire would have been almost entirely eliminated if fire fighters had been present. Elimination of all readily combustible material from topside exposure would have undoubtedly prevented most, if not all, of the fires.

V. Preliminary Recommendations.

HULL

The camber of weather decks should be increased. End connections of stanchions should be designed to allow the columns to buckle at their critical load without tripping the flange of the deck beams which they support. Additional recommendations pertinent to topside structure are listed in Part C, Item B, subitem (e), of this report.

MACHINERY

(a) Stacks and boiler casings should be made more resistant to blast pressure.

(b) Ventilation systems to vital spaces, such as engine rooms, should be located so they will not be exposed to the direct effects of blast pressure.

ELECTRICAL

From the damage sustained by the topside of this vessel, it is recommended that consideration be given to the elimination of the 36" searchlights on this type of vessel, since these searchlights are no longer used as originally intended; i.e., in conjunction with fire control. In the event these lights must be retained, it is recommended that the use of cast aluminum equipment be completely avoided. The searchlight yoke should be strengthened considerably and made from fabricated

steel. Castings should be avoided. Until such a time as a substitute for visual signalling can be provided, it is recommended that the 24" signalling searchlights be remotely positioned and controlled, in order that operating personnel may be in a protected location. It is assumed that signalling with short range signalling devices such as 12" signalling searchlights would be done from protected areas in the superstructure.

It is recommended that the exposed electrical equipment on this vessel be reduced as much as possible to insure maximum protection against the heat and blast of the atomic bomb. If this equipment must be exposed, it should be adequately covered with non-flammable enamel to insure protection against the heat of the blast.

TECHNICAL INSPECTION REPORT

SECTION I - HULL

GENERAL SUMMARY OF HULL DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

The draft readings taken just prior to, and immediately after the test are as follows:

	Forward	Aft	Mean	List
Before Test -	28' 0"	31' 0"	29' 6"	0 Degrees
After Test -	28' 0"	31' 0"	29' 6"	0 Degrees

Some seepage through the shell into four after voids in way of the skeg has occurred, but there was not enough water taken on board to change the trim or draft.

(b) Structural Damage:

Supersturcture - The sides and after face of the superstructure are mildly dished, showing the almost undirectional effect of the blast. The critical plate weight appears to be about ten pounds, with an additional advantage in strength being indicated for curved surfaces rather than flat panel areas of identical weight.

Light operational gear exposed to the blast such as antennae poles, radar screens, flag bags and searchlights are carried away. Both topmasts are down. Handrails and light bulwarks are intact but damaged, and overhanging structure on the port side is deflected upwards a small amount.

The upper deck, forward of the superstructure, is deflected between transverse bulkheads. Maximum deflections of four to six inches appear to starboard alongside of No. 1 turret. The deck beams and supporting structure conform to the deflection of the deck

and the deck beams are distorted in way of their connections to bulkheads and shell stiffeners. Stanchions and light bulkheads on the main and second decks, immediately below, are buckled slightly (see figure 1, page 94).

A rectangular section of the main deck, extending longitudinally between frames 86 and 91, port side, failed in two places. The longitudinal failure lines were 29 feet off the centerline and 13 feet off the centerline through a single riveted seam. The opening is approximately 20 feet long by 16 feet wide and is in way of a machinery access plate. The failure appears to be attributable, primarily, to a lack of supporting stanchions.

There is heavy deflection of the main deck aft as a result of blast. The most severe depression is slightly aft of No. 4 turret (figures 1 and 2, pages 94 and 99). This depression pulled the deck away from the after face of No. 4 barbette. The maximum deflection in this area is about 16 1/2 inches. Between frames 122 and 132 the maximum deflection is about 14 inches. The deflections of the main deck are accompanied by failure of supporting stanchions and distortion of connections of the deck beams to the shell stiffeners. The second deck is deflected aft of the armor from bulkhead 122 to about frame 134, the maximum being about 12 inches. The damage diminishes as it goes deeper into the ship.

The plane handling crane on the stern is collapsed. The catapult foundation is tilted forward as a result of the deck deflection.

The interior space under the failure in the port side of the main deck, frames 85 to 96, is heavily damaged by blast. There is evidence of mild shock in the second deck spaces aft of No. 4 barbette, such as failure of cast iron motor foundations, separation of covers in ventilation ducts, and failure of piping support brackets in way of their welded connection to the overhead.

Below the armored second deck there appears to be no structural damage, except that resulting from a mild blast wave conducted through the ventilation systems. This is confined almost entirely to the firerooms, where the boiler casings were ruptured.

The shell above the waterline is intact and appears to be in good condition, except for some panel dishing on the port and starboard quarter.

The exterior paint exposed to the blast is generally scorched and blistered through about one coat.

The only damage to the underwater body appears to be the seepage of water through the shell into four voids near the skeg.

(c) Other Damage: Machinery, electrical, ship control, fire-control, gunnery, electronics.

The airplane crane training gear is inoperable. All boilers are out of commission, and the ventilation system of the port engine room is not functioning. The whistle and siren are demolished.

Electrical cables running through the burned areas of the upper deck, frames 70 to 85, are burned.

Fire control has been reduced to some extent due to damage to the director and the loss of all fire control and search radar antennae.

The C.I.C. and all transmitting and receiving radio and electronic equipment is reported as undamage, except for the loss of all exposed antennae.

II. Forces Evidenced and Effects Noted.

(a) Heat.

The blast center appears to be about 210 degrees relative and at an approximate elevation of 45 degrees. The heat effect is not severe. Although on exposed surfaces, scorching is extensive, blistering is only moderate and extends not more than one coat down in 95% of the area affected. Nowhere does there appear to be more than two coats affected.

The wood covered weather decks are superficially scorched. Shell plating is scorched only on those surfaces facing the blast which composes practically all of the port side, stern, and a few frames of the starboard quarter. All exposed topside surfaces facing the blast are also scorched. In a few areas the scorching is heavier than average and nearby indirectly exposed surfaces are lightly scorched.

It is noted that the paint, covering wooden surfaces, is more heavily scorched than that covering steel surfaces under similar circumstances.

(b) Fires and Explosions.

The bulkheads and overhead structure in the steam table space A-0114-L, frames 70 to 84, upper deck level and adjoining spaces, are burned or blackened, apparently as a result of ignition of grease in the galley ventilation system, due to the intense fire in U.S. Army Quartermaster gear stowed on the open deck above.

Several holes are burned in the wood cover of the upper deck forward of No. 2 turret. It is reported that small pieces of canvas and metal grommets were found within the burned areas. It is believed, therefore, that these fires were caused by the burining of a new, unpainted, canvas wind breaker on the forecastle which was ignited by direct heat radiation (figure 1, page 34).

Aft, on the starboard side, a three square foot section of the main deck cover at frame 144 is burned away. It is believed that this fire was a result of the ignition of a coiled 1/2 inch manila line by radiated heat.

The only large fire on board occurred in U.S. Army gear placed on the exposed superstructure deck between frames 70 and 80. Individual fires breaking out in packed army clothing and subsistence rations, port and starboard, nearly destroyed all of this equipment. Material stowed along the centerline, afforded protection from the effect of direct radiation by the after superstructure, is relatively undamaged. Some canned and boxed food evidently exploded, many cans and sections of boxed rations being over fifty feet away from their original positions. It is believed that ignition of

these items was caused by radiated heat that penetrated into crevasses formed by the closely packed bales to a depth where the following air blast could not reduce the surface temperature below the kindling point by convection.

(c) Shock.

There is practically nc evidence of shock damage. On the second deck aft, below the depressed area of the weather deck, two cast iron intake blower motor housings have failed. Hangar straps are also broken loose from the overhead in a few instances. On these cases it is possible that the effect of the blast was transmitted rapidly to the immediate vicinity of these items through heavy stanchions added to support equipment stowed top-side.

(d) Pressure.

All of the structural damage is considered to be a result of air blast. There is some evidence of "focusing" of the blast in athwartship passages in the superstructre. Topside compartments that were closed off show light panel dishing on all outer surfaces, apparently as a result of increased outside air pressure. The light outer casing of the stack is severely distorted. Doors and door frames show considerable weakness where they are exposed to the blast. The weather deck is generally depressed, the after portion being dangerously weakened. The critical plate weight appears to be about ten pounds at this range.

The behavior of structure,,which in this particular vessel is mostley outmoded, (figures 4, 5, and 6, pages 101 , 102 , and 103) is of significance only to the extent that although directly exposed positions held up surprisingly well, an overall increase in designed strength of topside structure and the weather decks is necessary.

(e) Effects peculiar to the Atom Bomb.

Subjection of the ship, almost simultaneously, first to rather intense radiated heat and then to high structural loading by air blast throughout the entire length of the ship are the only effects

peculiar to the atomic bomb.

III. Results of Damage.

(a) Effect on machinery, electrical and ship control.

Propulsion was lost temporarily due to damage to boilers. Damage to considerable electronic gear is associated with the failure of topmasts, yardarms, and light superstructure plating.

(b) Effect on gunnery and fire control.

Although there is little damage to exposed gun mounts, it is quite evident that the present bulwarks and splinter shields do not offer any appreciable protection from this type of weapon. However completely enclosed mounts, even of relatively light weight, are undamaged and in good condition.

(c) Effect on watertight integrity and stability.

There is no appreciable effect on stability. The watertight integrity is impaired above the second deck aft of bulkhead 115, by the separation of the weather deck from the after face of No. 4 barbette, and above the third deck, aft of bulkhead 122, by the centerline separation in the second deck resulting from the punching action of misaligned stanchions. There is also a large hole in the main deck port side, aft of the break in the weather deck which has exposed the second deck between bulkheads 85 and 97.

(d) Effect on personnel and habitability.

It is evident that the casualty rate among exposed personnel would have been heavy. There is a slight reduction of habitability in crew's spaces on the second deck between bulkheads 85 and 97, and aft of bulkhead 115. The bakery and galley were unusable for a short period due to electrical failures and minor damage caused by fire in way of these spaces.

(e) Total effect on fighting efficiency.

The strength of the hull girder is but slightly impaired. The greatest effect on fighting efficiency, is the loss of power through damage to all boilers and the destruction of all electronic antennae incident to the failure of masts. The amount of reduction in efficiency d due to the high casualty rate among specially trained personnel because of inadequate protection from radiation and air shock, although unpredictable, appears to be of significance.

IV. General Summary of Observers' Impressions and Conclusions.

Although the ship is in sound condition, structurally protection against radiation and blast is inadequate. The destruction of masts supporting fire control, communications antennae, and venting of the blast into firerooms through the stack would have left the ship dead in the water and without adequate means of communication. Considering the time required to rig emergency repairs, this damage is believed to be critical.

V. Preliminary Recommendations.

The camber of weather decks should be increased. End connections of stanchions should be designed to allow the columns to buckle at their critical load without tripping the flange of the deck beams which they support. Additional recommendations pertinent to topside structure are listed in Part C, Item B, sub-item (e), of this report.

VI. Instructions for loading the vessel specified the following:

Item	Loading
Fuel oil.	33.3%
Diesel oil.	33.3%
Ammunition.	66.7%
Potable and reserve feed water.	Full load.
Salt water ballast.	1850 tons.
Gasoline.	33.3%

Details of the actual quantities of the various items aboard are included in report 7, Stability Inspection Report, submitted

by the ship's force in accordance with "Instructions to Targe Vessels for Tests and Observations by Ship's Force" issued by the Director of Ships Material. This report is available for inspection in the Bureau of Ships Crossroads Files.

DETAILED DESCRIPTION OF HULL DAMAGE

A. General Description of Hull Damage.

(a) Overall condition of vessel.

The shell plating is practically undamaged. The weather deck has been deflected and is weakened in the after half of the ship. Topside structure has suffered moderate panel dishing. With the exception of that portion of the ship aft of No. 4 barbette, the hull appears to be in good condition. General views of the exterior before and after the test are shown on pages 2 to 16, inclusive.

(b) General areas of hull damage.

The weather deck aft of No. 4 turret and the port side from frame 86 to 91, is badly damaged. Forward of frame 60, the deck is lightly damaged. All exposed portions of the superstructure have suffered varying degrees of damage (see figure 1, page 31).

(c) Apparent causes.

All the damage appears to be a result of blast.

(d) Principal areas of flooding.

There is a slight amount of flooding in voids adjacent to the skeg. This did not cause a noticeable change in the drafts, trim, or list.

(e) Strength, buoyancy, and effect of general condition of hull on operability.

Although the strength of the main deck, aft, is sharply reduced by major deflection between bulkheads, the residual longitudinal strength of the hull girder is nearly normal. Buoyancy is not affected. The condition of the hull does not reduce the operability.

B. Superstructure (exclusive of gun mounts).

(a) Description of damage.

Bridge area: At the top of the forward tripod, the S.G. radar antennae is carried away. Its pole mast is lying on the S.K. radar platform. (Photos 1859-5, 1909-12, pages 17 and 18.) The S.K. radar antennae is missing and its base casting is cracked. The 15 inch diameter pole mast supporting the radar platform is bent forward about 15 degrees and is wrinkled on the after face about 30 inches above the main battery director platform. (Photo 1935-11, page 19.) The starboard signal yardarm is lying on top of the 5 inch director and the port arm is twisted and bent. The top of the main battery director station is canted to starboard and pushed forward. The interior appears normal but the director is out of line. (Photos 1859-5, 1909-10, 9, 1900-3, 4, pages 17, 20, 21, 22, and 23.)

The 36 inch searchlight platform is rippled along the starboard side and bent upward along the after edge (10 pound platform plate and coaming). The starboard searchlight has carried away at the yoke and is lying on the superstructure deck. (Photo 1830-9, page 24.) The one inch pipe handrails are badly twisted (photo 1830-6, page 25). The port searchlight is demolished and the stand is torn from the foundation. The handrails are demolished. (Photo 1935-10, page 26.) The port platform has been cleared. (Photo 1911-6, page 27.) The 5 pound perpendicular plating of the forward AA defense station wings is battered and electronic equipment is damaged (photo 1830-7, page 28). The ladder up to the main battery director station is damaged but usable.

Five inch battery director platform, forward tripod. The director house is badly scorched but otherwise appears normal. The deck locker on the after port corner is mangled on the port and after faces. The top, forward, and starboard faces are dished mildly. The ladder leading to the platform above is twisted and out of place at the base.

A 5 pound plate screen between the after legs of the tripod is washboarded and the stiffeners are crumpled. There

is a 15 inch diagonal tear in the plating on the starboard side where the stack apparently hit the starboard leg and rebounded about 24 inches.

Open bridge platform, forward tripod. The after shield (10 pound plate) is bowed forward three inches and the 3/16 inch centerline stiffener is lightly crumpled. The after and port faces of the bridge urinal (5 pound plate), frames 66-67, are dished six inches and four inches respectively, for their full height. Also, in way of the port and after faces, the overhead welded connection is separated, the welded connections to the deck are intermittenly cracked, the vertical weld in the after port corner is open in a few places, and the forward welded connection on the port face is cracked from the deck to the overhead. (Photos 1911-11, 1911-12, pages 29 and 30.) The after side of the deckhouse is mildly dished. The port side (10 pound plate), is dished and the welds to the overhead wing brackets are cracked at the bottom of the beams. The port after corner of the open bridge wing is lifted about 30 degrees out of the horizontal plane, (photo 1742-7, page 31). The starboard wing platform and shield are undamaged.

Navigation bridge, forward tripod. The 40MM director tubs and their walkways appear intact. The port handrail is bent. The port bridge wing is out of line one foot aft. The welded stiffener connections are cracked at the top and bottom, (photo 1911-10, page 32). The port, after, and starboard faces (7.6 pound plate), of the bridge house are intact. The port and starboard doors are dished. The 60 pound bulkhead, frames 58 1/2 to 60 1/2, forming the pilot house are undamaged. The overhead beams supporting the open bridge platform above, show slight cracks in the vertical welded connections to the starboard bulkhead. Under the port wing the after beams have moved upward with the platform plating and pulled away from the face of the bridge house, tearing the bulkhead plating in way of the flange connection. (Photo 1742-7, page 31.) The beams are formed of 10" x 5" tapered to 6" x 3" T's.

Signal bridge, forward tripod, frame 64. The port wing platform is undamaged. The inboard edge of the after shield (10 pound plate) is bent forward 12 inches. The perforated

plate walkway (5 pound plate) is buckled. The starboard wing appears intact although the shield stiffeners show some compression. The after bulkhead of the deckhouse, frame 65, is slightly buckled. The port and starboard faces are in good condition. The radio shack located at frames 66 - 66 1/2 on the centerline, just forward of the stack, is dished about 12 inches on the forward and after faces and slightly dished on port and starboard faces. The door is deeply dished and the door frame is torn at top and bottom. (Photos 1911-9 and 2155-2, pages 33 and 34.)

Captain's level. All exposed surfaces on this level appear to be undamaged except for scorching and distortion of port and starboard intake louvres, of starboard vent louvres on the forward face and of the starboard door.

Superstructure deck. The outboard 10 pound shield for the port 20MM gun position is intact. The netting of the life raft basket is torn and the solid end is deeply dished. The inboard shield is pushed slightly inboard and the after edge has broken loose from the deck in way of the weld. (Photo 1910-6, page 35). The inboard shield of the starboard 20MM gun position is leaning inboard due to depression in the deck. The outboard shield is rippled and pushed outboard slightly.

At frame 50, between the port and starboard shields, the deck is dished a maximum of about 12 inches. (Photo 1935-9, 1910-5, pages 36 and 37.) This is directly beneath the overhang of No. 2 turret. The deflection of the deck framing has created a small crack along the connection of the forward face of the deck house, frame 52, to the top of the centerline hatch. The deck between frames 52 to 63, port and starboard, is undamaged.

The deckhouse sides, and port and starboard shields, frames 52-57, appear to be undamaged. A pipe handrail and stanchions on the port side, aft of frame 58, were damaged during removal of equipment in this area. (Photo 1910-7, page 38). The starboard railing, frames 82-83, is bent outward, whereas the port rail in this area is undamaged. Apparently this is the result of a reflection from a heavy armor slab secured to the deck just inboard of the starboard rail. (Photos 1910-2, 2154-11 and 10, pages 39, 40, and 41.) The hand-

rail, frames 62-78, are 1 3/4 inch diameter pipe with 2 1/4 inch diameter pipe stanchions.

The sheet metal, rectangular vent trunk, frame 65, port side of deckhouse, is dished throughout its full height. Four and one-half feet above the deck a seam is broken and the screen is missing from the opening. The stack is collapsed and is laid forward against a portion of the superstructure. (Photos 1910-8, 12, 11, and 1859-4, pages 42, 43, 44, and 45.) The top of the stack has been cut away in order to operate the boilers. The galley smoke pipe is carried away. (Photo 1900-6, page 46.) Between frames 65-71, port, and frames 71-76 from port to starboard, the superstructure deck is unobstructed. The athwartships space was covered by light weight, packaged, U.S. Army Quartermaster gear. The deck in way of this exposed area is generally dished a maximum of two inches. (Photos 1910-8, 9, and 10, pages 42, 47, and 48.) The after faces of the port and starbcard 40MM ready service locker (10 pound plate), frame 68-71, are dished. The circular gun shields (15 and 20 pound plate) mounted on top of these rooms are undamaged. Doors and door panels are moderately dished.

The after outboard leg of the starboard 40MM director tripod, frame 72, has pulled the deck up about three inches. (Photo 2137-8, page 49.) The forward legs of both port and starboard directors show signs of compression on the deck.

The main top mast carrying the An/CPN-6 radar beam is bent forward and to starboard. It is broken off about 18 inches above the main top and is left hanging over the side of the radar antennae platform, held only by several electrical cables. (Photos 1935-12, 1897-10 and 11, pages 50, 51, and 52.) Before breaking, considerable bending occurred and the mast cross-section changed from circular to elliptical. Luder's lines above and below the fracture indicate a fair degree of elongation before failing. The mast cross-section showed a crystalline structure with lack of cupping or "herring bone", indicating brittle failure. (Photos 1900-8 and 7, pages 53 and 54.) The S.C. and S.G. radar antennae are blown down from the radar antennae platform.

The main battery director station top is blown upwards about two feet at the after edge. The director is laying on the platform (photo 1911-5, page 55). The yardarms are bent upward and the port arm is pushed about five feet forward. (Photos 1935-12 and 1897-11, pages 50 and 52.) The radar antennae from the starboard yardarm is laying on the superstructure deck at frame 60 by the starboard ladder leading to the captain's level.

A hatch corner on the after AA defense station level, frame 81, is mashed downward about six inches and the cover is dished. (Photo 1911-8, page 56.)

The gun tubs and bulwarks on the 40MM defense station level and the 40MM platform appear to be undamaged but the port and after face of the superstructure and upper deckhouses are dished, handrails are demolished, and the decks are wrinkled. (Photos 1911-1, 1911-3, 1909-8, pages 57, 58, and 59.) The range-finder booth of No. 3 turret is caved in. The wiring trunks running along the port side of the upper deckhouse bulkhead between frames 87-96 are collapsed. (Photo 2154-9, page 60.) The door to the optical shop is demolished. The interior spaces of the after superstructure appears to be in good condition. Except for a slight wave (about 1/8 of an inch) in the upper deck bulkhead at frame 76 1/2, which was deflected by the forward starboard leg of the mainmast through its base on the superstructure, no other signs of overloading the mainmast tripod could be found.

(b) Causes of damage.

All structural damage in the superstructure appears to be the direct results of air blast and pressure.

(c) Evidence of fire in superstructure.

The area in way of the port steam table space, compartment A-0114L, upper deck, is scorched and blackened in varying degrees on the overhead and interior bulkheads. Apparently, the grease contaminated galley vent systems must have become overheated by the fires initiated in U.S. Army Quartermaster

supplies on the deck above. The result is similar to that left by a flash oil fire of intense heat, which left a thick deposit of carbon and unburned heavy grease on all surfaces.

Paint on exterior surfaces was blackened and blistered where directly exposed. Cordage was scorched. U.S. Army Quartermaster gear stowed on the superstructure deck, frames 70 to 80 was ignited, apparently by radiation, and burned, (photos 1832-9, page 61).

(d) Relative effectiveness against heat and blast.

1. The critical plate weight appears to be 10 pounds.

2. Curved surfaces appear to be superior to flat panel areas.

3. As far as panel deflection and buckling is concerned, there appears to be little difference between mild and special treatment steels.

4. Structurally, aluminum is unsatisfactory.

(e) Constructive criticism of superstructure items is given below in the order of their importance.

1. The elimination of all exposed light weight plating, omission of overhanging platforms and open passageways, and the enclosure of all exposed stations.

2. The use of curved or spherical sections to replace all exposed vertical surfaces.

3. An increase in deck camber and strengthening of deck structure.

4. Improvement and strengthening of ladder connections, runners, and treads.

5. Elimination of castings as foundations, ladder connections, runners and treads, etc.

6. Considerable study should be given to the relative merits of heavy airfoil tower structure solidly framed and supported clear into the keel structure vs., unipolar, tripolar and sextipolar mast structures. Serious consideration should also be given to the feasibility of tower structure equipped with retractable or expendable and readily replaceable masts.

C. Turrets, Guns, and Directors.

(a) Protected mounts.

General condition, including operability, if known: Turrets 1 to 4, inclusive. The turrets are only slightly damaged and the operability is not affected in any way. All leather bucklers on turrets 1 and 2 are intact except the one on the left gun of turret 1, which is torn. The canvas bucklers on turrets 3 and 4 are in shreds. The ventilation ducts under the overhang of all turrets are badly dished and welded seams at the edges have failed. The ducts (7 1/2 pound plate) are constructed of 58 1/2 inch by 72 inch panels. A continuation of this same duct runs up the outside and is welded to the rear side plate of the turret armor box. On turret 4, all of these connecting welds have failed.

Five-inch/38 twin mounts: The 5 inch mounts are only slightly damaged and the operability is reduced temporarily by about 50 per cent because of an ordnance breakdown. This breakdown is the result of damage to an oil line inflicted by a small platform which was inadequately bolted to the side shield plate. On the two after mounts and the starboard forward mount, the gun port bucklers are destroyed and the metal frames are twisted and warped.

Effectiveness of installed turrets or shields: Satisfactory.

(b) Unprotected mounts.

General condition, including operability if known: 40MM twin mounts are lightly damaged but operable. 20MM twin mount at frame 124, starboard, is demolished by debris. The mounts at frame 124 and 143, port, are inoperable in train. All other 20MM mounts are undamaged and operable.

Effectiveness and sufficiency of crew shelters: The shields provide little protection for the crew against heat and blast.

(c) Directors and rangefinders (In enclosed mounts).

General condition, including operability, if known: The rear bulkhead and door of the rangefinder structure built as an appendage on the rear of turrets 2 and 3, is badly dished. (Photo 1742-6, 1911-2, pages 62 and 63.) In turret 2 the rangefinder's left port cover is dished in. Operability is not affected.

Condition of instruments therein: Minor damage.

(d) Constructuve criticism of design or construction of mounts, directors, foundations and shelters.

No comment.

D. Torpedo Mounts, Depth Charge Gear.

Not applicable.

E. Weather Deck.

(a) General condition of decks and causes of damage.

The forecastle deck is slightly buckled between transverse bulkheads, a maximum of four to six inches along the starboard side of No. 1 and No. 2 turrets. The superstructure deck is badly dished locally in way of the overhang of No. 2 turret, frame

50, and is generally dished between frames and longitudinals in the exposed area between the foremast and main mast superstructure, frames 65 to 76. The main deck, port, has given away in the vicinity of a machinery access patch, frames 87 to 90. The major weather deck damage occurs aft of No. 4 turret where the main deck is pushed down between transverse bulkheads a maximum of 16 1/2 inches (Figures 1 and 2, pages 94 and 99) in way of frame 119. Deck deflection gage readings are given in figures 8 and 9, pages 105 and 106.

The wooden deck covering is scorched where directly exposed to radiation effects. In a few local areas the wood has been burned through due to the presence of highly inflammable materials in direct contact with the deck.

It is believed that air blast is the direct cause of all structural weather deck damage. In addition, there is damage to weatherproofing caused by radiation.

Between frames 8 and 23 the upper deck is deflected downward in one smooth dish about 1/2 inch in depth. Another dish of about the same proportion runs aft of frame 23 to frame 29 and extends past the port side of No. 1 turret to frame 38. The dishing is more pronounced on the starboard side of No. 1 turret where the deflection is about six inches between frames 32 and 38. (Photo 1909-11, page 64.) From frames 40 to 49, starboard, the deck is down about four inches. A local area directly above the starboard stanchion at frame 45 has remained in place, and appears as a bulge in the deck.

The exposed portion of the upper deck between frames 60 and 78 consists of a port and starboard, wood covered overhanging walkway, 29 inches wide. The starboard walkway appears to be undamaged. The port walkway wooden cover is charred and the after corner is moved upward about three inches at the outboard edge, frame 77 1/2, and tapers down to zero just forward of frame 70.

The superstructure deck is the midships weather deck and is covered in detail under Item B.

Just aft of the break of the weather deck, there is a failure in the main deck between the deckhouse and the port rail. The break runs aft from frame 86 to frame 91 and extends outboard from the port edge of the deckhouse to a riveted lap seam just two and one-half feet inboard of a longitudinal bulkhead on the second deck. The opening is about 20 feet long by 16 feet wide. (Photos 2137-6, 1747-2, and 2137-7, pages 65, 66, and 67.) The hole is in way of a soft patch used as a machinery hatch, but does not conform to the limits of the patch. The failure consists of a transverse break in the deck along the after face of the deck beam at frame 88, which is limited at either end by the inboard and outboard hatch boundaries. The tear progresses two frames beyond the forward boundary of the machinery hatch, (photo 1742-10, page 68) and is terminated aft at frame 91 by a heavy supporting stanchion. (Photo 2136-11, page 69.) The structure in way of the damage is difficult to analyze. Apparently the patch has been removed and replaced by various methods at different times. However, the damage may be attributed in part to the initial failures of riveted deck beam connections at the hatch boundaries, (Photos 2136-11, 10, 2137-4, 3, 5, 2, 1, and 2136-12, pages 69, 70, 71, 72, 73, 74, 75, and 76.) and primarily to the omission of supporting stanchions under the patch. The portion of the main deck in way of the starboard soft patch is reinforced by additional stanchions installed to support heavy equipment mounted on the deck for test purposes. This area is intact and in good condition.

The main deck, aft to the after edge of No. 4 turret, is in good condition. The deck supporting structure in this area has been strengthened by additional shoring in order to accommodate heavy ordnance equipment. Therefore, it is not certain what the condition might have been under normal structure and topside condition. (Photos 1911-7, 1893-10, pages 77 and 78.)

The exposed areas of the main deck aft of No. 4 turret, frame 116 to the stern, are depressed between bulkheads. (Photos 1909-3, 1935-2 and 1909-2, pages 79, 80, and 81.) A maximum deflection of 16 1/2 inches is recorded along the centerline midway between the after face of the No. 4 barbette and the structural bulkhead at frame 122. (Photo 1909-6, page 82.) The break in the wood deck cover at frame 122 extends 13 feet to starboard and 14 feet to port of the centerline. The decking is pulled

away from the face of the barbette. (Photo 1935-5, page 83.) The dimensions and measured deflections of this area are given in detail in figure 2, page 99 and a study of the scantlings in figures 4 and 5, pages 101 and 102.

Wooden deck covering is burned, apparently from burning canvas at frame 9 near the starboard waterway, at frame 21 near the port rail, and at frame 39, port. (Photos 1743-2, 1, and 1742-11, pages 84, 85, and 86.) At frame 144, starboard, a small section of wood decking is burned apparently from a coil of line. (Photo 1817-1, page 87.) All of the deck surfaces exposed directly to radiation are scorched.

(b) Usability of deck.

The deck is usable except around the hole in the port main deck, frames 86 to 91, and where the usability is slightly reduced aft of No. 4 turret due to the loss of support from buckled stanchions and broken deck beams below.

(c) Condition of equipment and fittings.

Mooring and towing fittings: All cleats and bits are in good condition.

Boats and boat handling, life rafts: Winches at the stern have cracked foundations and bent shafts. Both anchor windlasses have had their vertical shafts sprung by deck movement. The shafts now gradually creep upward until the keys work out, allowing the anchor chain to run free. No boats are onboard. The port quarter deck boat boom was thrown up on deck. (Photos 1900-5, 1889-7, and 5, pages 88, 89, and 90.) The port gangway is demolished. One starboard gangway davit is missing. The port davit, frame 105, is damaged. (Photo 1889-8, page 91.) Some life rafts are demolished, others are burned or missing and only three are in good condition.

Airplane handling gear; catapults: The airplane handling boom, frame 80, starboard, is undamaged. (Photo 1893-9, page 92.) As a result of the present condition of the deck the base of the catapult at frame 131 is tipped forward allowing the

catapult to touch the deck. (Photos 1909-3 and 5, pages 79 and 93.) The stern airplane crane bridge work has failed making the crane inoperable. (Photos 1889-9, 1889-10, 2198-1, and 1889-12, pages 94, 95, 96, and 97.)

F. Exterior Hull (above waterline).

(a) Exterior hull plating - causes and damage.

The shell plating, port and starboard, appears in good condition. Panel dishing is noticeable on the port counter just forward of the sponson, (Photo 50-118, page 10.) and to a lesser degree on the starboard quarter. This is apparently blast damage.

(b) Hull fittings.

No damage.

(c) Sheer strake.

No damage.

(d) Side armor belt.

No apparent damage.

G. Interior compartments (above armor deck).

(a) Damage to structures and causes.

Structural damage on the upper deck is confined to the overhead structure in way of its connection to the foremast tripod legs, exposed areas of the superstructure deck, and gun and director tripod connections. The transverse beam at frame 50, sick bay space, is cracked about 15 feet from the port side. The deck beam, frame 66, crew's space, is distorted and bracket connections to longitudinal bulkheads are buckled as a result of direct and reflected blast attack on the deck above, plus the overturning movement of the director tubs located just aft of frame 66 on the super-

structure deck. (Photos 2154-4, 2154-8, pages 98 and 99.) Tripod leg connections to the superstructure deck, deck beams and longitudinals are damaged. (Photos 2137-12, 2154-3, 2137-9, 2154-2, 2154-1, 2137-10, 11, 2154-6, 5, pages 100, 101, 102, 103, 104, 105, 106, 107, and 108.) The exposed bulkheads forming port and starboard deck house sides appear normal, except for depression of overhead structure at frames 61 and 62, starboard, (Photo 1910-1, page 109) and at frames 82-87, starboard, where slight buckles appear, apparently caused by blast tunneling between the deckhouse and the 5"/38 mount. (Photo 1910-3, page 110.)

Structurally, the main deck and overhead are intact forward of frame 12. The deck beams are strained in way of connections to vertical structure and the shell brackets (located on even numbered frames only) are slightly buckled at frame 12, port and at frame 16, port and starboard; at frames 17 and 18, starboard; frame 24, port and starboard; and at frames 25 and 27, starboard. See figure 3, page 100.

In the wardroom A-126L, frames 23 to 30, the overhead is deflected about a maximum of six inches on the starboard side. The flange of the starboard deep longitudinal is crippled in way of frame 27 and the web shows stress cracks in the paint about 18 inches aft of the flange damage. The longitudinal is also stressed around the opening for the ventilation duct which passes through it at frame 24 1/2, and in way of the stanchions at frames 25 and 28. The stanchions are buckled and the main deck is locally dished about three inches in way of each stanchion. (Photos 2155-5, 2155-6, pages 111 and 112.) The stiffeners under the starboard deep longitudinal at bulkheads 23 and 30 are buckled in way of the overhead bracket connections. The centerline longitudinals are stressed and show signs of slight deflection. The centerline stanchions at frames 25 and 28 are buckled. (Photo 2155-7, page 113.) The deck beam, frame 26, is stressed just to starboard of the centerline longitudinal, and the web is distorted in way of the starboard outboard stanchion. The port longitudinal is also stressed around the opening for the ventilation duct which passes through it at frame 24 1/2.

The after wardroom bulkhead is stepped, the

central portion is on frame 30 and the ten-foot wing portions are on frame 29. The central portion is distorted. Just inboard of the starboard shell, deck beams 34 and 35 are buckled. The split beam bracket at frame 41, starboard, is buckled in the web. The deck beam at frame 44 is deflected downwards about three inches between the starboard shell plating and the first stanchion inboard (about 15 feet), the flange of the beam is fractured about four feet inboard of the shell. At frame 45 the deck beam failed at a butt in way of the second longitudinal inboard of the starboard shell plating (welded flange, riveted web) and the inboard portion is down about two inches, relative to the outboard portion. The butt connection is obviously inadequate and apparently contributed to the deck depression in this area. At frames 47 and 48 the deck beams are slightly deflected between the starboard shell and the stanchions approximately 12 feet inboard. The port outboard stanchions in way of frames 36 and 38 are buckled, the longitudinal at frame 39 is stressed and the port stanchion is buckled slightly. (See figure 3, page 100.)

At frame 57, a short bulkhead 15 inches long between the port shell and the circular bulkhead of the 5 inch handling room is buckled horizontally. There is evidence of a relative displacement of at least one inch between the port shell and the 5 inch handling room circular bulkhead.

There appears to be no other damage on that portion of the main deck forward of the break in the weather deck at frame 85. The damage sustained by the main deck aft of frame 85 is reported in detail under Item E, Weather Deck.

Forward of frame 13, on the second deck, there is no apparent damage. At frame 13, the transverse beam and overhead bracket are pulled away about one-half inch from the starboard connection. The transverse beam at frame 19 is buckled in way of the starboard bracket connection. The deck beam on frame 20 is buckled immediately inboard of a four inch diameter pipe stanchion located five feet inboard of the starboard shell. At frame 21, the transverse beam and overhead bracket are separated at the starboard connection by approximately two inches. The beam is also stressed in way of a riveted clip connection to the overhead about five

feet inboard of the starboard shell. The transverse beam on frame 22 is stressed at the starboard frame bracket.

At frame 25, the starboard stanchion is offset about one foot from the stanchion on the deck above. As a result, the web of the deck beam is buckled in shear. (Photo 2155-10, page 114.) The deck above is down a maximum of about one-half inch directly below the main deck stanchion. A similar but more severe failure occurs at frame 28. The deck is down about one and one-half inches and the tripping bracket is separated from both the web and the flange of the beam. The same type of failure appears in way of the port stanchions at frame 25 and 28. The main deck is down locally, about one inch at each stanchion. The tripping brackets, however, are intact.

The bulkhead at frame 50 is buckled to a depth of about one-inch in way of the overhead just outboard of the starboard watertight door.

The bulkhead at frame 85 is bulged forward slightly from centerline to port, apparently as a result of the main deck failure immediately aft. Bulkhead 97 is bulged aft about five inches on the port side and also very slightly on the starboard side. (Photo 2136-6, page 115.) Apparently bulkheads 85 and 97 acted as transverse boundaries limiting the blast pressure which entered through the weather deck failure. The fact that the main deck deflection is negligible in this area must be due in part, to the equalization of pressure above and below the main deck between these bulkheads. At the forward edge of the opening blown in the main deck, the port stanchions at frames 86 and 87 are crushed and the stanchion at frame 91 is buckled. (Photos 2136-11, 10, page 69 and 70.) The stanchions supporting the main deck along the inboard edge of the port machinery access are undamaged. (Photo 2137-1, page 75.) In addition to the buckled stanchion on the port side, the deck beams at frames 91, 92, and 93 are tripped forward three to four inches in way of the athwartship port quarter point. (Photo 2136-9, page 116.) Ventilation ducts, piping and electrical wiring in this area are demolished. (Photos 2137-5, 2136-4, pages 73 and 117.)

The starboard stanchions located similarly to those above are buckled, including one at frame 93, located 10 feet to starboard of centerline. Six-inch diameter pipe shoring was installed under the main deck in the starboard area to support special equipment installed for the test. These supports were placed in two rows on frames 88 to 91 at approximately three feet and six feet inboard of the starboard longitudinal bulkhead, and two pairs on frames 91 and 94, at about nine and ten feet inboard. The inboard pair at frames 91 and 94 are slightly buckled. It is believed that these additional supports prevented a failure in the main deck similar to that in way of the port side soft patch.

Bulkhead 115 is bulged on both port and starboard sides of No. 4 barbette. Bulging of the port section buckled the door and door frame. The starboard section has a two-inch maximum bulge forward between the starboard door and No. 4 barbette. The overhead structure to port appears to be down about one-inch.

The general depression of the main deck aft of bulkhead 115 has caused the failure of many second deck stanchions and damage to bulkheads and overhead structure in this area. Between bulkheads 115 and 122, compartment D-203-1L, the overhead is generally down, the deflection varies from zero at bulkheads 115 and 122 to over 16 inches at the centerline of frame 119. (Figure 2, page 99 .) The centerline bracket connecting the main deck to the after face of number four barbette has failed and the deck has pulled two inches away from the barbette. (Photo 2136-3, page 118.) Adjacent brackets are loose. Overhead brackets along the port and starboard shell from frame 118 to 121 are tripped slightly or show signs of working under the deck deflection.

The deflection of the main deck in compartment D-203-1L is more noticeable in the area extending from the row of five-inch diameter pipe stanchions running longitudinally about seven feet to starboard of the centerline to another diagonal row about 20 feet to port of centerline. The starboard row of stan-

chions, frames 117 to 121 are crushed near the base and buckled forward in way of their upper quarter point. The port stanchions frame 118 - 121 are also buckled forward, but to a lesser extent. (Photo 2136-2, page 119.) Between these rows of stanchions, a distance of some twenty seven feet, there are only two remotely placed stanchions. A row of vertical 3 1/2" diameter pipes were installed 15 1/2 feet to starboard of the centerline as shoring for ordnance equipment stowed topside. These are also buckled slightly.

The designed deck height is maintained at bulkhead 122, which appears to be in good condition. The second deck (armored) from frame 115 to 122 is undamaged.

In the space between frames 122 to 132, compartment D-203-4L, main deck, overhead, is down. The deflection increases from zero at frame 122 to a maximum of approximately 14 inches at frame 128, then degreases gradually to about four inches at the centerline of bulkhead 134. (Figure 2, page 99 .) The armor on the second deck ends about 15 inches aft of bulkhead 122. From this point aft, the second deck is deflected downward, apparently by loading applied to the weather deck and transmitted through supporting stanchions. (Figure 1, page 94 .) The deflection of the second deck reaches a maximum of about 12 inches relative to the third deck at frame 128 along the centerline.

The double, ten-inch channel, overhead deck beams, (Figure 4, page 101.), are tripped in way of their connections to the port and starboard frames. Deck beams at frames 128 and 129 are crushed (there are no brackets) and the frames themselves are tripped just above the second deck level. Between frames 124 and 127, starboard, the transverse beam brackets are wrinkled and have begun to separate in way of their connections to the frames. The frame flanges are crumpled at the lower edges of the bracket. This is apparently due to the moment set up by the considerable downward deflection of the beams along the centerline of the ship. The deck beams at frames 130 and 131 of single 10-inch channels are tripped aft in way of their starboard bracket.

The depression of the second deck in this area is carried well to port by additional stanchions (3 1/2" diameter pipe) added to support ordnance equipment stowed above. The stanchions are buckled and there is a 1/16 inch wide crack running along the inboard edge of the port 40 pound stringer plate between frames 126 and 128. The 5-1/2 inch diameter pipe stanchions, port and starboard, at frame 123 are badly buckled and the centerline stanchion has buckled enough that the material in way of the fold in the pipe (compression side) has failed. The remainder of the stanchions in the space have stood up well, although they show signs of working under the main deck deflection and have pushed down the second deck in the vicinity of their bases.

The 5-1/2 inch pipe stanchion at the centerline on frame 125 is out of line with the third deck stanchion below. As a result of the load transmitted through the second deck stanchion the transverse deck beam under the second deck has been sheared and distorted. The stanchion below has carried away at its connection to the beam and has opened the second deck plating above it. The plating was forced up and extruded over the rivet heads aft about two feet and forward to frame 124. At frame 124, between a stanchion just to port of the centerline and another six feet farther to port, the deck is separated along a riveted seam.

Between frames 128 and 131, (compartment D-206-1 L) a heavy support ring is built into the overhead structure in order to distribute the loads imposed by the plane catapult above. The 5-1/2 diameter pipe stanchions which carry the load down to the second deck are spaced at equal intervals around the ring. They failed in way of their connections to the support ring.

Bulkhead 132 is staggered, the central section being on frame 134. The starboard section of this bulkhead, on frame 132 is buckled by the deflection of the overhead. However, the starboard watertight door and frame are in good condition. The 10 pound starboard longitudinal section of this bulkhead is dished inboard.

In compartment D-206-2L, crews W.C., frames 132 to 139. The starboard brackets have failed from frames 133 to 138. The port brackets are tripped aft from frames 134 to 136 and stiffeners are collapsed by bulged port shell plating (figure 5, page 102). The stiffeners

have also failed in tension. The shell appears to have moved in about five inches, maximum. The overhead deck beams at frames 135 and 136 are tripped and have separated at the centerline butt welded connections. The stanchions at frame 135 and 136 are buckled, those at 137 and 138 are not buckled but their riveted connections to the deck beam are loose. Bulkhead 139 is slightly crumpled, but apparently watertight.

The training gear room compartment D-210-E, frames 140 1/2 to 145 (extreme stern), is structurally intact. The crane machinery is reported to be inoperable. There is some evidence of shock or violent displacement, as some stowed gear is down on the deck.

There is no damage on the third deck forward of frame 90. A stanchion in the radio transmitter room, C-325-C, frame 91, near the centerline, is slightly buckled. In compartment D-310-L, the starboard 5 1/2 inch pipe stanchions at frames 117 and 118 are slightly buckled (the overhead, second deck, consists,of approximately 5 inches of armor).

In the crew's space, compartment D-312-L, frames 122 to 131, the overhead (12 1/2 MS deck) is down about one foot in a local area approximately 12 feet to starboard of the ship's centerline at frame 128, and down about five inches at frame 129, centerline. The riveted connections of many stanchions to the deck beams have failed and the tops have pushed up the overhead second deck plating, opening riveted seams along the centerline, frames 124 and 125. These failures allowed water from topside to accumulate in this space.

Stanchions of 3 1/2 inch diameter pipe added as shoring for heavy ordnance equipment topside, located at the centerline of frame 128 and about 15 feet to port of the centerline at frame 127 are buckled.

(b) Damage to joiner bulkheads.

On the main deck in compartment A-116-L, the joiner bulkheads at frame 15, separating staterooms L and M, starboard, DD and EE, port, are buckled two to three inches, maximum. The passageway bulkheads, port and starboard, are buckled between frames 15 and 16. The joiner bulkheads at frames 16 and 17, starboard, are also buckled. The above damage is apparently due to a mild deflec-

tion of the overhead structure in this area.

In compartment A-140-L, the port joiner bulkhead, dividing staterooms W and X, is buckled just outboard of the port stanchion.

On the second deck in Compartment C-291-1L, frames 87 to 94, the port and starboard bulkheads of the general mess scullery and pantry are distorted. (Photo 2136-5, page 120). The longitudinal joiner bulkhead along the centerline, frames 94 to 97 was destroyed, apparently by blast entering this compartment through the failure in the main deck, frames 86 to 91, port side. (Photo 2136-8, page 121).

The joiner bulkhead enclosing the crew's water closet and the barber shop, frame 118, second deck, starboard, is buckled in way of the overhead.

The port pasaageway joiner bulkhead in compartment D-208-2T, frames 139 to 141, is dished about four inches maximum. The joiner door was torn from its hinges and blown to port. It is now lying about three feet inside of the 20 MM ready service room. The door frames is mangled. The remainder of the compartment appears to be undamaged. The cause of this damage is apparently due to the blast which must have entered the passageway through the overhead hatch in the main deck, at frame 140, starboard.

(c) Details of damage to access closures and fittings.

The port and starboard doors in transverse bulkhead 85 are dished forward. The port door in bulkhead 97 is dished aft about 3 1/2 inches, maximum, (Photo 2136-7, page 122), and the starboard door is also slightly dished. This damage is apparently due to the entries of blast pressure into the space between frames 85 and 97 through the failure in the main deck in way of frame 88.

The port side hatch cover at frame 115 on the main deck was blown off.

(d) Equipment in compartments below decks is in good condition

with the exception of crushed lockers and other light equipment in the scullery, tailor shop and other areas in way of the collapsed portion of the weather deck.

(e) Evidence of fire.

There is no evidence of fire below the upper deck.

(f) Damage in way of piping, cables, ventilation ducts, etc.

In compartment C-291-1L, 2nd deck, piping, cable and ventilation systems were completely disrupted in way of the break in the main deck, frames 86 - 91, port side.

In compartment D-203-1L, second deck, the hot air system duct appears to be about 75% efficient, and the blower motor frames is fractured in way of the rear bearing housing. About 65% of the regular air supply ducts are intact in this compartment.

In compartment D-203-4L, the intake to the starboard blower is down. The cast iron legs of the blower motor are fractured apparently due to shock. The port blower of the hot air system appears to be operable. The duct is in fair condition, however, close inspection is impossible due to insulation. A water main entering the crew's water closet (compartment D-206-2L) at frame 134 1/2 and angling to starboard has failed in two places and a large 12 by 18 foot section is down on the deck.

(g) Habitability and utility of compartments.

The habitability and utility of compartments below decks is only temporarily impaired. The watertight subdivision of the ship is slightly impaired in way of frame 116 1/2 along the after face of #4 barbette, where the main deck pulled away from the barbette, and at frames 124 to 125, centerline of second deck, which was opened yp by the stanchions below punching through the deck plating. The port side of compartment C-291-1L, frames 85 to 96, is also exposed by the failure of the main deck just aft of the break in the weather deck.

H. Armor decks.

(a) Damage.

The armor decks are intact and appear undamaged. However, there are slight buckles in large 5-1/2 inch diameter pipe stanchions on the third deck level at frames 117 and 118 indicating a slight relative displacement between the 5-inch armored second deck and the 1-1/2 inch armored third deck (Splinter deck). The deflection was apparently all elastic.

(b) Complete protection was afforded spaces below the armor decks.

(c) Condition around openings.

1. Hatches are undamaged.
2. Gratings are undamaged.
3. Openings in way of uptake bulkheads are undamaged.
4. The armor decks in way of barbettes are undamaged.

(d) Armor deck connections to the vertical armor are undamaged.

I. Interior Compartments (Below the waterline.)

(a) Damage to structure and causes.

In compartment D-431-L, frames 122 to 129, first platform, the centerline stanchions at frames 123 to 128 are slightly buckled. The third deck appears to have a small permanent deflection.

In the steering gear compartment, D-437-E, first platform the large port and starboard stanchions at frame 133 are crushed at the top and base and show stress lines in the paint. The deck beam brackets on the overhead, frames 136 to 138, port and starboard, show signs of working. The rudder post packing gland is leaking at a rate of about six to ten gallons per hour.

(b) Damage to joiner bulkheads.

None.

(c) Damage to access closures.

None.

(d) Condition of equipment within compartments.

Intact and undamaged by the Test.

(e) Flooding.

None.

(f) Damage in way of piping, cables, ventilation ducts, etc.

A large ventilation duct located near the port shell in the after machinery space, C-4-E, is blown open at a connection near the overhead, frame 87.

(g) Estimate of reduction in watertight subdivision, habitability and utility.

None.

J. Underwater Hull.

(a) Interior inspection of underwater hull.

There is no known damage to the underwater hull except that the following four voids had some seepage from the sea; D-26-V, D-35-V, D-36-V, and D-43-V. (See Item L).

(b) Effect of damage on buoyancy, operability, maneuverability.

No noticable effect on buoyancy, operability or

manuverability.

(c) Any known or suspected damage to shafts, propellers, struts, rudder or external keels.

There is no known damage to the underwater hull appendages.

(d) Details of impairment of keel structure.

There is no known impairment of the keel structure.

K. Tanks.

(a and b) Condition of tanks, contamination of liquids.

Apparently, there is no flooding or contamination in the tanks, although four voids have some seepage. (See Item L).

(c) Damage to torpedo defense system.

On the night of 10 July 1946, an oil tanker, lying alongside caused some leakage in the port blisters, upper and lower, frame 60 to frame 90.

L. Flooding.

(a) Major flooding areas.

There is some seepage in four stern voids (see figure 1, page 94).

(b) Source of flooding.

Leakage is believed to be through seams in the shell.

(c) List of compartments believed to have flooded slowly so as to be susceptable to damage control.

The following voids flooded slowly:

D-26-V	(18 inches of water).
D-35-V	(60 inches of water).
D-36-V	(64 inches of water).
D-43-V	(49 inches of oil and water).

The total flooding was not enough to change the drafts, trim, or list.

M. Ventilation.

(a) Damage to ventilation system and causes.

On the superstructure deck, frame 87, starboard, a vent cowl was damaged (Photo 1910-4, page 123).

On the main deck, in way of frame 103, on the port side of No. 3 barbette, an exhaust duct was blown forward and to the deck. An exhaust duct at frame 96 is also damaged.

On the second deck, overhead blower trunks running aft from bulkhead 85 on the port side, were broken and carried to the deck by failure of the overhead structure. (Photo 2137-5, page 73). The supply duct for this blower was burst open, apparently by blast conducted through it from topside (Photo 2136-4, page 117). The port exhaust duct in way of frame 104 was blown open, apparently by blast conducted from the weather deck.

In compartment D-203-1L, frames 115-122, second deck the hot air system duct appears to be about 75% efficient. However, the blower is inoperable due to the fracture of the motor casting in way of its bearings, apparently due to mild shock transmitted from top side through additional stanchions placed near by. The regular air supply system appears to be about 65% intact in this compartment. In compartment D-263-4L, at frame 123, the duct work to the starboard blower is down and the blower motor foundation casting is fractured, apparently due to mild shock. The port blowers of the hot-air system is intact and appears to be operable.

On the third deck only a small amount of damage oc-

curred, apparently by the transmittal of blast through the system.

On the second platform - There is a small amount of damaged duct work reported in the forward dynamo room, frames 54 to 60.

2. Closures.

No damage.

3. Effect on habitability.

Very minor effect, if any.

(b) Evidence that ventilation system conducted heat, blast, fire or smoke below decks.

Apparently some heat, or fire, was conducted through the ventilation system in way of the galley and steam table spaces, superstructure deck level, frames 70 to 84, from a fire originating on the exposed deck above. Some blast was conducted to the blower room, third deck, frames 82 to 84. Some ventilation ducts on the port side are bulged and opened at seams just under the weather deck, indicating transmissions of blast from topside.

(c) Evidence that ventilation system allowed progressive flooding.

None.

(d) Constructive criticism of design and construction of system.

Crimped and riveted ventilation ducts are easily opened when exposed to blast pressures, either externally or internally and elbows are especially vulnerable. The performance of spot welded and arc welded ducts aboard other vessels indicate that fabrication in this latter manner is superior to crimping or riveting. Ventilation systems employing ducts or rectangular cross section appear to be more vulnerable to blast than pipes of approximately round cross-section. However, they might be found, because of their superior strength, to conduct the blast further below decks.

N. Ship Control.

(a) Damage to ship control stations and causes.

1. Bridge area.

None.

2. C.I.C.

No damage, except for loss of antennae.

3. Gyro-compass equipment.

The ship reports a six degree error in the repeater on the open bridge. The port alidade pelorus stand is broken. (Photo 1830-8, page 124).

4. Steering gear.

No damage.

5. Interior communications.

Ships force reports that three general announcing topside reproducers were broken by the blast. The wind direction and intensity transmitters were carried away.

6. All navigation lights were blown overboard or damaged beyond repair.

(b) Constructive criticism of ship control systems.

No comment.

O. Fire Control.

(a) Damage to fire control stations and causes.

1. Directors and elevated control positions.

Protected directors and control stations are intact. The directors in Spot 1 and Spot II being only protected by light metal splinter shield and canvas received the direct effect of the blast. The director in Spot I was knocked out of line but suffered little other damage. The director in Spot II was knocked off its base and is totally unusable, although the director itself can be repaired.

Control for the two 40 MM twin mounts, being exposed suffered directly from blast and flying debris. No. 2 Mk 51 director is damage beyond immediate repair from falling debris from the stack. The Mk 51 director for twin mount No. 3 is operable but the Mk 51 sight is damaged from blast. The alignment is unknown.

The four auxiliary directors (Mk 51-2) for the 5"/38 battery are undamaged but the two Mk 15 sights for No. 3 and No. 4 directors were damaged by the blast.

2. Plot rooms and protected spaces.

No damage.

(b) List of stations having insufficient protection and estimated effect on fighting efficiency of the loss of each.

All exposed stations are insufficiently protected from blast and heat. Not only does a loss in efficiency result from damaged instruments but personnel would become casualties.

(c) Constructive criticism of location and arrangement of stations..

Personnel and equipment in open stations should be provided with some sort of protection against the blast and heat of the bomb

P. Ammunition Behavior.

(a) Ready service ammunition, location, protection, behavior

under heat and blast.

Satisfactory.

(b) Magazine, location, protection, forces involved, behavior.

Satisfactory.

(c) List of stowages which are insufficiently protected and effects on ship survival of explosion of each stowage.

None.

(d) Behavior of gasoline stowage facilities.

No gasoline on board.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling devices.

No damage occurred. Operability is not affected.

(b) Evidence that any ammunition handling devices contributed to passing heat, fire, blast or flooding water.

None.

(c) Constructive criticism of design and construction of ammunition handling devices.

No comment.

R. Strength.

(a) Permanent hog or sag.

There is no apparent hog or sag attributable to the Test, although there might be a slight amount of sag due to the dishing of the

main deck which tends to shorten the topside. Ship survey measurements and studies are given in appendix, page 95).

(b) Shear strains in hull plating.

No evidence.

(c) Evidence of transverse machinery strains.

None.

(d) Details of any local failures in way of structural discontinuities.

The main deck aft of No. 3 and No. 4 barbettes pulled away from the barbettes. In the crews W.C. on the second deck, beams under the main deck at frame 135 and 136 have failed by separation at their centerline butt welds. On the third deck, in way of frame 125, the transverse deck beam under the second deck is crushed due to misalignment of stanchions immediately above and below.

(e) Evidence of panel deflection under the blast.

Light plating of bulkheads and bulwarks in the superstructure is dished. The main deck is seriously dished aft of frame 115, and there are slight waves in the starboard forecastle forward of No. 1 turret.

(f) Turret, machinery and gun foundations.

All turret, main machinery and gun foundations are reported intact and undamaged.

S. Miscellaneous.

Paint work is scorched and blistered on structure facing the blast (Photos 1743-10, 6, pages 125 and 126). Wood weather deck covering is charred where exposed to the direct path of radiation. Uncharred shadows of equipment are clearly outlined (Photos 1909-1, pages 21 of 127).

TECHNICAL INSPECTION REPORT

SECTION II - MACHINERY

GENERAL SUMMARY OF MACHINERY DAMAGE

I. Target Condition After Test.

(a) Drafts after test: list; general areas of flooding, sources.

No data taken by machinery group.

(b) Structural damage: superstructure, hull, interior of hull, above and below armored deck (if fitted).

The outer casing of the stack was torn away at its base on the port side. The stack was dished in, especially on the port side, and was crushed in at the top. The inner casing of the stack and the upper part of the uptakes were badly crushed. Deflection of decks and bulkheads, especially collapse of the main deck soft patch, caused considerable damage to piping. Ventilation ducts to both enginerooms were severely damaged. The crane boom was twisted at its base and bent over to starboard but the crane machinery is operable.

(c) Damage: machinery and ship control.

All boiler casings failed, brickwork was moderately damaged. Damage to the stack partially closed the gas passage from the boilers. All forced draft blower suction flaps were bent and jammed closed. There was considerable local damage to piping, mostly caused by failure or deflection of supporting structures. The whistle and siren were knocked off and demolished. The crane was damaged structurally.

II. Forces Evidenced and Effects Noted.

(a) Heat: apparent direction (if any); extent longitudinally, transversely, penetration, significant behavior of structure or equipment.

Paint on exposed machinery w : scorched and blistered. Otherwise, there was no evidence of heat on machinery or in machinery spaces.

(b) Fires and Explosions: situation; nature of combustible or explosive; normal stowage; cause of ignition; extent and result.

Not evidenced.

(c) Shock: apparent direction (if any); areas affected; critical scantlings; nature of joint failures (general); effect on machinery and equipment; significant behavior of structure or equipment.

Some breakage of small piping was probably caused by shock. Leads left in the bearings of the port low pressure turbine indicate motion of the turbine journals not exceeding .007 inches.

(d) Pressure: apparent direction (if any); areas affected; critical scantlings; general nature of failures; significant behavior of structure and equipment.

Blast pressure caused nearly all damage to the machinery installation, either by its direct effect or by deflecting decks and bulkheads which in turn damaged piping, etc. This includes damage to the stack, boilers, crane, ventilation ducts, and force draft blower flaps. The pressure wave apparently came from near the port quarter.

(e) Any effects apparently peculiar to the Atom Bomb.

A blast pressure of this magnitude at the range of the NEVADA from the explosion is apparently peculiar to the Atom Bomb.

III. Effects and Damage.

(a) Effect on machinery and ship control.

All steam power was lost by damage to boilers and stacks. Damage to ventilation ducts would have made the port engine room and possibly the starboard engine room untenable. It is estimated that temporary repairs to boilers and ventilation ducts to enable the ship to steam at slow speed could have been made by the ship's force within 48 hours. It is estimated that approximately 20 days' work at a shipyard would be required to restore the machinery installation to normal operation. The crane is inoperable because of structural damage. Damage to piping was of purely local significance and would have had little, if any, effect on any important system. Except for reduction of power available, the test had little effect on ship control as far as machinery is concerned.

(b) Effect on gunnery and fire control.

No comment.

(c) Effect on watertight integrity and stability.

No comment.

(d) Effect on personnel and habitability.

It is estimated that casualties among fireroom personnel would have been high if the boilers had been steaming. It is not believed that there would have been any other casualties among personnel below decks.

(e) Total effect on fighting efficiency.

The ship was temporarily immobilized. She could probably have been gotten underway at slow speed within 48 hours.

IV. General Summary (Not over 6-8 lines) of observers' impressions and conclusions.

It is not believed that boilers of a modern battleship would have been damaged severely enough by this test to immobilize the vessel. Damage to the stack of a modern battleship would probably have caused some reduction in steaming capacity.

V. Any preliminary general or specific recommendations of the inspecting group.

(a) Stacks and boiler casings should be made more resistant to blast pressure.

(b) Ventilation systems to vital spaces, such as engine room, should be located so they will not be exposed to the direct effects of blast pressure.

DETAILED DESCRIPTION OF MACHINERY DAMAGE

A. General Description of Machinery Damage.

(a) Overall Condition.

1. There was major damage to the boilers and smokestack. The crane was damaged structurally and is inoperable. Damage to ventilation ducts leading to the enginerooms left the port engineroom with no forced ventilation and greatly reduced that to the starboard engineroom. The intake flaps of all forced draft blowers were jammed shut, making the blowers inoperable until the shutters are cleared. There was considerable damage to piping but not enough to seriously impair the function of any important system.

(b) Areas of Major Damage:

Firerooms #1 to #4 inclusive, and smokestack.

(c) Primary Causes of Damage in Each Area of Major Damage.

1. Blast pressure caused most of the damage. Breakage of some small water lines was probably caused by shock.

(d) Effect of Target Test on Overall Operation of Machinery Plant.

1. All boiler power was lost. The port engineroom is untenable because of damage to ventilation ducts, cutting off all forced ventilation to this space. Damage to ventilation ducts leading to the starboard engineroom would impair efficiency of operation of this space and might have forced its temporary abandonment if it had been operating. All forced draft blowers were out of commission until the suction flaps were straightened, which required lifting of the casings of the blowers. The crane is inoperable because of structural damage. Damage to piping is of local significance only and has little effect on operation.

2. It is estimated that temporary repairs to boilers and ventilation ducts, to enable the ship to steam at slow speed on two boilers, could be made by the ship's force within 24 hours. Damage to the stack would make it impossible to steam at high speed even if all boilers were available. It is estimated that approximately 20 days' work by a shipyard would be required to restore the machinery plant to normal operation.

3. It is estimated that casualties among fireroom personnel would have been very high. There would have been few, if any casualties among other personnel below decks.

NOTE: Temporary repairs were made to boiler #6 and this boiler was steamed after Test A.

B. Boilers.

(a) Air Casings.

1. Air casings of all boilers failed similarly but to varying degrees, boiler #6 being the least damaged and boiler #4 the greatest. In all cases the side casings bulged out and failed along the panel joints. The packed panels were ruptured in the majority of cases so that the packing was exposed. Removable panel joints were made up with hinged bolts which tighten on a notched flange on the adjacent panel. These joints came free without appreciable damage to the panel flanges. Where standard bolts were used, the sheet metal of the panel failed by tearing through at the bolt holes. (See Photos 1875-7 and 8; pages [illegible] and [illegible]). Where the ship's structure was close to the boiler casing and held one side in place, damage to the other side was correspondingly greater.

2. Rear walls were bulged out and distorted around the steam drum connections. This occurred to a marked extent on #4 boiler where the rear wall and casing moved outward as much as 18 inches, but no rupture or panel failures occurred except in the side casings. (See Photos 1876-1 and 2; pages 130 and 131).

3. Brick pans showed little evidence of distortion but cracks in the furnace floors indicate that some sagging of the brick pans possibly occurred.

(b) External Fittings.

1. External pressure fittings appeared to be intact after the blast. Hydrostatic tests of boilers revealed no damage to fittings.

2. No fittings except the smoke indicators were affected by the blast. Some smoke indicators were slightly damaged when the reflecting units were blown open by the blast and the mirrors were broken.

(c) Fuel Oil Burner Assemblies.

1. The oil pressure parts of fuel burners appear to be undamaged. The air doors of some burners are slightly distorted and operate stiffly.

(d) Brickwork.

Brickwork in general stood up well. Sidewalls of all boilers are in good condition and front walls are almost intact except for corbels being cracked in two boilers with small amounts broken off. Rear walls were pushed out to varying distances. (See Photos 1876-1 and 2; pages and . Boiler #6 rear wall has not moved perceptibly. Boiler #4 rear wall had moved approximately 18 inches. This condition is due to the casing behind the wall bulging out. Floors, especially those in boilers #2 and #5, were cracked due to the dishing of the brick pans.

(e) Steam and Water Drums.

1. All pressure parts are apparently undamaged. Hydrostatic tests indicate no appreciable change in tightness of the hydrostatic pressure systems.

2. Boilers 2 and 5 were left under hydrostatic pressure of 300 lbs/sq. in. and boiler No. 3 under steam pressure of 300 lbs/sq. in., when the ship was abandoned before the test. Upon return of the crew after an absence of approximately 48 hours boiler No. 2 had 82 lbs/sq. in. in pressure remaining. The other boilers had no pressure remaining.

(f) Tubes.

See (e) above.

(g) Foundations.

All foundations are intact.

(h) Stacks and Uptakes.

1. The stack was dished in on all sides but to the greatest extent on the after port side which was nearest to the blast. The stack was crushed in at the top and ripped free of the cowling which was demolished. (See Photos 1875-11 and 12; pages 132 and **133**. The inner and outer stacks were crushed in so as to restrict the gas passage.

2. The outer stack was torn away at the base on the port side. (See Photo 1875-10; page **134**). The plate sheared at the bolt holes at the base where the bolts were about 3/4" diameter. Failure at joints in the upper part of the stack was due to shearing of rivets.

3. Uptakes below deck are undamaged. They are considerably distorted at the point where they join the stack.

HYDROSTATIC TESTS ON BOIER #2

TIME	BEFORE TEST A.	AFTER TEST A.
0000	300 #	310 #
0100	292	305
0200	282	300
0300	276	295
0400	271	290
0500	264	285
0600	259	273
0700	255	268
0800	253	260
0900	251	255
1000	249	250
1100	248	245
1200	246	241
1300	244	236
1400	242	232
1500	240	230
1600	238	228
1700	237	224
1800	236	219
1900	235	216
2000	234	211
2100	233	208
2200	232	204
2300	231	200
2400	230	195

C. Blowers.

1. The intake flaps of all blowers were driven closed past the stops. It was necessary to open the blower casings to adjust the flaps. This was done by the ship's force.

2. Except for the above, the blowers are undamaged. They were operated under service conditions after Test A.

D. Fuel Oil Equipment.

Undamaged. All fuel oil equipment has been operated under service conditions since Test A.

E. Boiler Feedwater Equipment.

Undamaged. All boiler feedwater equipment has been operated under service conditions since Test A.

F. Main Turbines

Undamaged. The turbines were turned over by steam after Test A. There has been no change in axial clearances as determined by measurements. See report of leads left in bearings during the test (below). It will be noted that only slight motion of the turbine journals is indicated; not exceeding .007 in any case.

PORT H. P. TURBINE - FORWARD BEARING.

Forward Lead	Before Test A	After Test A	Difference
Port	.011	.011	.000
Top	.012	.010	.002
Stbd	.010	.009	.001
Center Lead			
Port	.013	.012	.001
Top	.0135	.0135	.000
Stbd	.013	.013	.000

HYDROSTATIC TESTS ON BOILER #5

TIME	BEFORE TEST A	AFTER TEST A
0000	300 #	300 #
0100	288	297
0200	283	290
0300	280	281
0400	277	270
0500	275	264
0600	272	256
0700	270	250
0800	268	244
0900	266	238
1000	264	236
1100	262	232
1200	260	227
1300	257	223
1400	254	218
1500	250	214
1600	246	208
1700	238	202
1800	230	199
1900	222	197
2000	212	194
2100	210	191
2200	208	186
2300	206	180
2400	204	175

After Lead	Before Test A	After Test A	Difference
Port	.010	.010	.000
Top	.009	.009	.000
Stbd	.007	.007	.000

PORT L. P. TURBINE - FORWARD BEARING

Forward Lead			
Port	.012	.009	.003
Top	.011	.007	.004
Stbd	.010	.007	.003

Center Lead			
Port	.017	.014	.003
Top	.017	.011	.006
Stbd	.016	.009	.007

After Lead			
Port	.013	.010	.003
Top	.012	.008	.004
Stbd	.011	.007	.004

G. Reduction Gears.

Undamaged. The reduction gears were inspected after Test A through the inspection holes while the shafts were being jacked over one complete revolution.

H. Shafting and Bearings.

Undamaged. Shafting and bearings were inspected while the main turbines were being turned.

I. Lubrication System.

Undamaged. All parts of the system were operated under service conditions after Test A.

J. Condensers and Air Ejectors.

Undamaged. All condensers, radojets for main condensers, and air ejectors for dynamo condensers were operated under service conditions after Test A and maintained vacuum of 28 1/2".

K. Pumps.

Undamaged. All pumps were operated under service conditions after Test A.

L. Auxiliary Generators (Turbine and Gears).

Undamaged. All Turbo-generators were operated under load after Test A.

M. Propellers.

Undamaged. The propellers are not accessible for inspection. A check during operation of main turbines indicates no damage to them.

N. Distilling Plant.

Undamaged. The distilling plant was placed in normal operation immediately after Test A, with no change in the quantity or quality of water distilled.

O. Refrigerating Plant.

Undamaged. The refrigerating plant was placed in normal operation immediately after Test A. Performance is normal.

P. Winches, Windlasses, and Capstans.

1. No. 3 deck winch is inoperable be :ause of an electrical failure. No mechanical damage was found on inspection.

2. One finger of the electric controller for the anchor windlass was bent by the blast, making this unit inoperable. This was easily repaired by the ship's force and this unit is now operable, no other damage having occurred.

3. There was no damage to any of the remaining equipment included under this heading, all of which was operated under service conditions after Test A and functioned normally.

Q. Steering Engine.

Undamaged. The main steering system has been tested from all steering stations. The emergency steering pump has been tested satisfactorily.

R. Elevators, Ammunition Hoists, Etc.

1. Elevators.

Not applicable.

2. Ammunition hoists.

The ammunition hoists were not damaged and were operated by power.

3. Airplane crane.

The airplane crane is inoperable due to damage to its boom. The boom is twisted and bent to starboard apparently from the effects of blast pressure. The crane machinery below deck appears to be undamaged.

S. Ventilation (Machinery).

1. Numerous vent sets are out of commission because of structural and electrical failures.

2. Vent sets affecting the engineering department out of commission are:

Both exhaust fans to port engine room (Frame 92 and 95, port, second deck).

Both supply fans to port engine room (Frame 81 and 83, port, second deck).

Forward supply fan to starboard engine room (Frame 94, starboard, second deck).

3. Failure of these ventilation sets would have necessitated abandoning the port engine room if the ship had been underway unless the weather was very cold.

T. Air Compressors.

Undamaged. The air compressors were operated under service conditions after Test A. Performance was normal.

U. Diesels (Generators and Boats).

Undamaged. The two 100 KW diesel generators and the two diesel fire pumps were operated under service conditions after Test A. Performance was normal.

V. Piping.

(a) Main Steam.

All main steam lines are intact except for broken main steam gage lines in boiler rooms numbers 1, 3, 5 and 6. The gage lines were torn off as a result of boiler air casing damage.

(b) Auxiliary Steam.

All piping is intact and has been tested to design pressure except the whistle and siren piping. The latter piping is badly twisted and bent due to distortion of the outer smoke stack. The whistle and siren were knocked off when the stack was blown against the bridge structure.

(c) Auxiliary Exhaust.

All lines are intact nd have been tested at design pressure.

(d) Condensate and Feedwater.

All lines are intact and have been tested at design pressure.

(e) Fuel oil.

All lines are intact and have been tested at design pressure.

(f) Lubricating Oil.

All lines are intact and have been tested at design pressure.

(g) Fire Main and Sprinkling.

The fire main and sprinkling system is intact except as noted below. All piping not damaged has been tested at full pressure and is now being used.

(1) Between frames 85-86, port side, second deck, the line leading up to fire plug 1-88-2 was sheared off at the weld between the elbow and riser stop valve. The elbow ahead of the strainer fractured through the casting. Damage was caused by giving way of the soft patch in the main deck to which the line was attached. As a result of this damage, it was necessary to shut off the supply to fire plugs 1-88-2 and 02-85-2.

(2) A section of the branch line between frames 120-123, second deck, serving fire plugs 1-116-1 and 1-116-2 was pulled apart at the flange bolts at both ends of the section. Damage was caused by deflection and whipping of the deck, which at this point has a permanent set of about 10 inches as a result of Test A. This damage necessitated shutting off the supply to fire plug 2-121-1 in addition to plugs listed above.

(3) A branch of the fire main in the crew's water closet aft of frame 134, second deck, was pulled apart at the flange on the discharge side of the branch line cut out valve and the complete line torn from its hangers and attached plumbing fixtures. Damage was caused by deflection of the deck to which it was attached.

(4) In number five fire room, frame 75, port side, the screwed line (lead lined) to the fire plug within the room was broken off directly at the thread on the discharge side of the cut out valve.

(h) Condenser Circulating Water System.

All lines are intact and have been tested at design pressure.

(i) Drain Main.

All piping is intact and has been tested under operating conditions.

(j) Compressed Air.

All compressed air piping is intact and has been tested at design pressure except as noted below.

A section of air test piping is sheared off at the inboard longitudinal bulkhead of compartment C-219-2L at about frame 84. This damage was caused by rupture of the deck soft patch to which the line was attached. Damage to this line affects only compartment air testing in this area.

(k) Hydraulic System.

All piping is intact and has been tested at design pressure.

(l) Gasoline System.

A section of the after outboard main was ruptured during the fragmentation bomb test held prior to "A" Day. All piping except this line appears to be intact. It was not tested. No damage was done to this system by Test A.

(m) Fresh Water System.

The fresh water system is intact and is being operated except as follows:

(1) At frame 85, second deck, port side, a twenty foot section of the deck filling main was badly bent, twisted and torn apart by rupture through the cast elbo connection to the main deck at one end and by rupture of the pipe at the other end. A branch line was torn away from the filling line. Damage was caused by rupture of the deck soft patch to which the piping was attached.

(2) A branch line at frame 121, second deck, which leads to the barber shop had a crack two inches long caused by deflection of the deck to which it was attached.

(3) The fresh water branch to crew's washroom and to the hot water heater at frame 128-129, starboard side, second deck, pulled apart at three screwed joints and one section of pipe was sheared off. All connections at the heater were torn off (steam and drain lines included) close to the heater. Damage was caused by deflection of the overhead deck to which the piping was attached and also to the buckling of the bulkhead to which the heater was attached. (It is estimated that the deck had a whipping deflection of 18 inches and now has a permanent set of about 12 inches).

(4) The screwed piping for lavatory faucets in crew's washroom D-206-1L was bent and pulled apart at three threaded joints. The remaining lines are intact. Damage was caused by whipping of lines which were not securely supported.

(5) The starboard deck filling screwed cap connection at frame 25 was broken off at a 45° angle. This damage was caused by impact of a heavy object. Tearing off of the cap necessitated blanking off the line so that the remainder of the system could be used. No isolating valve is installed.

W. Miscellaneous.

1. Galley electrical equipment was inoperative because of a fire which burned out wiring to this equipment. The equipment was not damaged mechanically and was placed in service after the wiring was replaced.

2. Laundry, ice cream, and machine shop equipment were undamaged. This equipment has been operated under service conditions since Test A.

TECHNICAL INSPECTION REPORT

SECTION III - ELECTRICAL

GENERAL SUMMARY OF ELECTRICAL DAMAGE

I. Target Condition After Test.

(a) Drafts after test; list; general areas of flooding, sources.

Not observed.

(b) Structural damage.

In the areas of structural damage the adjacent or attached electrical equipment was damaged by deformation of the supporting structure or by being struck by missiles. This occurred in the mast structures, on the second deck at frames 86 to 91 port, and aft of frame 126, port and starboard.

(c) Damage.

The following electrical equipment received damage during this test:

1. Searchlights.
2. Running anchor and signal lights.
3. Magnesyn, and magnetic compasses.
4. Gyro repeaters and alidades.
5. Topside announcing system reproducers.

II. Forces Evidenced and Effects Noted.

(a) Heat.

Radiant heat of the blast singed the topmost layers of

paint on cables, wireways, and electrical equipment directly exposed to it, but failed to affect their electrical properties.

Several fires in Army Quartermaster supplies exposed on the 02 deck between frames 71 and 86 port and starboard, burned through the wooden deck and overheated the cables in wireways on the 01 deck directly beneath it. The heat was sufficient to burn out a number of these cables which caused a loss of power to galley equipment.

(b) Fires and explosions.

Fires in extremely combustible Army material exposed on the boat deck damaged lighting and power cables in the overhead of the compartment below, and destroyed phenolic type lighting fixtures, and connection boxes which were located in such a way as to receive conducted heat through the overhead.

No evidence of explosions was noted.

(c) Shock.

Although subjected to a large amount of pressure, very little acceleration was imparted to this vessel. Accordingly, there was little evidence of shock damage to electrical equipment on this vessel.

(d) Pressure.

Blast pressure accounted for most of the damage to electrical equipment mounted topside. Starboard 36" searchlight was completely demolished by the blast, and the resulting fall to the boat deck. The port 36" searchlight was badly bent and its stand was torn from its foundations by the blast pressure. This damage resulted from failure of cast aluminum construction. Other evidence of damage by blast pressure was noted in the damage to alidades, announcing system reproducers, and other electrical equipment located in exposed places on the topside of this vessel.

(e) Any effects apparently peculiar to the atom bomb.

A radiant heat flash, quickly followed by an extremely powerful, and relatively slow acting blast wave are characteristic of this weapon.

III. Effects of Damage.

(a) Effect on machinery, electrical, and ship control.

There was no effect on propulsion and electrical ship control equipment as a result of electrical damage to this vessel.

(b) Effect on gunnery and fire control.

There was only minor damage to gunnery or fire control circuits, except the damage to cables in the galley area by heat from fires on the deck above, which put the AA directors in that area out of commission.

(c) Effect on watertight integrity and stability.

Damage to electrical equipment did not affect watertight integrity or stability.

(d) Effect on personnel and habitability.

Damage to the galley area reduced the habitability for a period of about 3 days, until emergency circuits could be run to the bake shop and galley equipment. Ventilation sets suffered minor damage. No other electrical damage had any effect on the habitability of the vessel.

(e) Total effect on fighting efficiency.

The electrical damage reduced the fighting efficiency only by the loss of searchlights, certain fire control equipment, and reduction of telephone communications to the heavy machine gun control amidships.

IV. General Summary of Observer's Impressions and Conclusions.

Electrical damage to this vessel resulted from the effects of blast on masts, superstructure, and the main deck. This involved searchlights, fire control, and communication equipment topside; vent blowers on the second deck; and cable runs in the galley area, and pinched or broken cable runs in the vicinity of structural damage in the main deck aft of frame 90. No electrical damage occurred within the armored box of the hull. Some of the blast damage would have been eliminated by the changes in design which has already been made in modern equipment. Cast aluminum bases, stands and searchlights, pelorus stands, and similar equipment were particularly susceptible to the damage by blast pressure, and provided examples of obsolete design which now have been proved to be inadequate. The damage by fire would have been almost eliminated if fire fighters had been present.

Elimination of all readily combustible material from topside exposure would have undoubtedly prevented most, if not all, of the fires.

V. Any preliminary general or specific recommendations of the Inspecting Group.

From the damage sustained by the topside of this vessel, it is recommended that consideration be given to the elimination of the 36" searchlights on this type of vessel, since these searchlights are no longer used as originally intended; i.e., in conjunction with fire control. In the event these lights must be retained, it is recommended that the use of cast aluminum equipment be completely avoided. The searchlight yoke should be strengthened considerably and made from fabricated steel. Castings should be avoided. Until such a time as a substitute for visual signalling can be provided, it is recommended that the 24" signalling searchlights be remotely positioned and controlled, in order that operating personnel may be in a protected location. It is assumed that signalling with short range signalling devices such as 12" signalling searchlights would be done from protected areas in the superstructure.

It is recommended that the exposed electrical equipment on this vessel be reduced as much as possible to insure maximum protection against the heat and blast of the atomic bomb. If this equipment must be exposed, it should be adequately covered with non-flammable enamel to insure protection against the heat of the blast.

DETAILED DESCRIPTION OF ELECTRICAL DAMAGE

A. General Description of Electrical Damage.

(a) Overall condition.

The overall condition of the electric plant on this vessel was good. All major electrical units were still operable after the test.

(b) Areas of major damage.

Major electrical damage to this vessel occurred on the upper decks, and superstructure in the main mast, and foremast. There was additional electrical damage on the 01 deck level in compartment A-0114-L.

(c) Primary causes of damage in each area of major damage.

The blast effect of the above surface burst caused all of the superstructure damage. Fire in Army Quartermaster test equipment on the boat deck caused damage to the electrical cables, compartment A-0114-L.

(d) Operability of electric plant.

The overall electrical operability was only slightly reduced. Searchlights, navigational lights, and minor topside electrical equipment were destroyed or badly damaged, but the main electric plant and its vital parts were unaffected. Ship control, fire control, communications systems and all power generating units generally remained in the same condition of operability as before the test. Ventilation sets suffered minor damage.

(e) Types of equipment most affected.

Searchlights, navigational lights, cables and cable supports in areas exposed to blast suffered the greatest amount of damage.

B. Electric Propulsion Rotating Equipment.

Not applicable.

C. Electric Propulsion Control Equipment.

Not applicable.

D. Generators - Ship's Service.

No damage.

E. Generators - Emergency.

No damage.

F. Switchboards, Distribution and Transfer Panels.

No damage.

G. Wiring, Wiring Equipment and Wireways.

All topside cables on this vessel that were exposed directly to the blast had their painted surfaces charged. However, the cables themselves were not damaged by the heat. Apparently, the heavy coat of paint on these cables afforded the necessary protection against the heat of the blast. There were numerous cable failures in the superstructure exposed locations on this vessel. These were primarily due to extreme hull failure or distortion. Several fires in Army Quartermaster equipment exposed on the 02 deck between Frames 71 and 86, port and starboard, burned through the wooden deck, and overheated the cables wireways on the 01 deck directly beneath. The heat was sufficient to burn out a number of these cables, which caused a loss of power to galley equipment. Most of the cables were the obsolete LPA type (lighting and power, armored) and failed at a much lower temperature than the modern HFA or FPA Navy cables.

The only wireway supports that were damaged on this vessel were those that were carried away due to the failure of the hull structure.

Connections, junction boxes, receptacles and plugs, suffered only minor damage due to the blast in the superstructure area. Several wiring boxes had their covers blown off by the pressure of the blast.

Recommendations.

(a) In those weather deck locations where it is necessary to expose cables, the cables should be adequately covered with heat resistant enamel to insure protection against the heat flash.

(b) Reduce the number of exposed cables as much as possible, to insure maximum protection against the heat and blast of the atomic bomb.

H. Transformers.

No damage.

I. Submarine Propelling Batteries.

Not applicable.

J. Portable Batteries.

No damage.

K. Motors, Motor Generator Sets, and Motor Controllers.

A vent motor mounted athwartship on vent set No. 3-96-2 had its end bell cracked. This motor had a cast iron frame which was broken when the shaft was pushed back by the extreme blast pressure coming down the vent duct. The motor was manufactured by the General Electric Company, Type MP Serial No. 423604, 8-1/2 horsepower. The Westinghouse controller used in conjunction with this motor had its enclosure slightly distorted,

but the interior was still intact.

The vent motor for vent set No. 2-119-2 had its end bell casting broken at the bearing housing. The brushes also had been displaced from the commutator. The motor was identical to the motor for vent set No. 3-96-2. This damage was also caused by the blast coming down the vent duct. The motor controller for this unit was distorted but operable.

The Westinghouse controller Type ESN-6201, Style 1366750, with a type GMG panel was used in conjunction with the radio control of the starboard 36" searchlight. This controller was located on the 36" searchlight platform. Although the adjacent searchlight was completely demolished, the motor controller was in very good shape. The only derangement noted was that the pull-out spring failed to disengage the contactor when no voltage was applied to the holding coil.

Discussion and Recommendations.

The damage to these vent motors resulted from the failure of cast iron frames. This damage would have probably been greatly reduced or avoided, if modern Navy type steel motors had been installed. Since the damage was caused by air blast coming down vent ducts, it would be desireable to eliminate vent openings to the weather deck if practicable. This could be accomplished by installing a recirculating type air conditioning system. Undoubtedly there are more important reasons why these hull openings should be closed, but their closure would greatly aid motor performance.

L. Lighting Equipment.

Lighting fixtures and lighting appliances showed an extreme suitability to withstand shock and blast. The only lighting fixtures that were damaged were those that were apparently struck by flying missiles. It was of particular interest to note that the lighting fixtures installed under the main deck which had collapsed between frames 85 and 90 were intact. In this instance, the rough service lamps installed under this deck section had

their filaments broken, while the high impact lamps installed in this same area were operable.

In the galley area, in compartment A-0114-L most of the ceiling fixtures were burned. These fixtures were of the 9-S-4665-L type. In most cases these fixtures were demolished with the exception of the interior sockets.

The aft anchor light was blown free of its foundation and cable, and lost overboard. All other running lights aft had been removed before the test. All signal and running lights mounted on the mast were blown free of the ship, from the extreme pressure of the blast. The starboard running light was blasted from the ship. The only two operable running lights on the ship were the port side light and the masthead light.

It was interesting to note that the fluorescent lighting fixtures mounted in the captain's cabin were undamaged. These were commercial type fixtures.

Recommendations.

Instrumentation data indicates that the running, anchor, and signal lights had been subjected to the following blast pressures:

Anchor light - 35 pounds per square inch.

Lights on mast - 24.5 pounds per square inch.

Side lights - 23.5 pounds per square inch.

These are all approximate values. It is recommended the resistance of these lights and their mountings to air blast be improved.

M. Searchlights.

36'' searchlights.

The starboard 36'' searchlight was blown off the searchlight platform by the blast and fell to the boat deck where it was found in a completely shattered and demolished condition. The searchlight was dislodged from its original position due to failure of the cast aluminum yoke. The damage to this searchlight is shown on photograph 1830-6, page 24 and 1830-9, page 23.

The port 36'' searchlight was badly damaged by the blast. The cast aluminum yoke fractured and base mounting bolts stripped out permitting the searchlight to topple over on its back. The glass door and iris shutter were completely destroyed; however, the metal mirror, and the positive and negative heads were intact inside the searchlight barrel. The damage to this searchlight is shown in photographs 1830-4, page 135, 1830-5, page 136, and 1911-4, page 139.

24'' searchlights.

The starboard 24'' searchlight was undamaged except for the glass door being broken, and iris shutter mangled. It is believed that this searchlight withstood the blast due to the protection afforded by the pilot house. The damage to this searchlight is shown in photograph 1830-10, page 137.

The port 24'' searchlight toppled over due to the failure of the cast aluminum base under the excessive blast pressure. The face glass and shutter were demolished. The positive and negative heads were slightly damage but intact. It is believed the heads could be put in operation with small repair work. The damage to this searchlight is shown in photograph 1830-11, page 138.

12'' searchlights.

The port 12'' signalling searchlight mounted on the signal bridge was blasted out of its clamp tight mounting and dropped to the boat deck. Further inspection indicated that the glass

on this searchlight was intact, but frosted black from the excessive radiant heat of the burst. The shutter was operable and the case only slightly distorted. Due to the strange reaction of this searchlight glass to the blast, the searchlight glass was marked for forwarding back to the Bureau of Ships for inspection.

The starboard 12'' signalling searchlight was undamaged due to the protection from the blast afforded by the superstructure.

The excessive damage to the searchlights can be directly attributed to the failure of the cast aluminum frames. It was noted that no power supply or control cables leading up to these searchlights were destroyed or damaged.

Recommendations.

Instrumentation data indicates that the 36'' searchlights were subjected to an air blast of approximately 24.5 pounds per square inch, and the 24'' searchlights to an air blast of approximately 23.5 pounds per square inch.

(a) It is recommended that the use of cast aluminum equipment be completely avoided.

(b) The searchlight yoke should be strengthened considerably and made from fabricated steel. Castings should be avoided.

(c) The base mounting and king pin arrangement appears to be a weak point in the design and should be improved.

(d) Searchlights should be made more resistant to air blast.

(e) Consideration should be given to the elimination of the 36'' searchlights, since they no longer are used as originally intended, i.e., in conjunction with fire control.

(f) Until such a time that a substitute for visual signalling can be provided, it is recommended that the 24" signalling searchlights be remotely positioned and controlled, in order that operating personnel would be in a protected location.

It is assumed that signalling with short range signalling devices such as the 12 inch searchlights will be done from protected areas in the superstructure.

N. Degaussing Equipment.

Magnesyn compass and standard magnetic compass compensating coils damage discussed under Item O.

O. Gyro Compass Equipment.

The gyro compass repeater on the open bridge, MK VII, Mod. 1, had its glass cover broken. The unit was still operable, but had an error of 6° .

The MK XXXII Mod. 6 self-synchronous alidade on the starboard side of the pilot house wing was operable, although the paint had been scorched on the pedestal and cover. The same unit mounted on the port side of the pilot house wing, had its cast aluminum pedestal smashed. Photograph 1830-8, page 123, shows this damage.

A magnesyn compass and stand were blown off of its mounting, resulting in the distortion and displacement of the magnesyn compass compensating coils. Photograph 1935-12, page 49, shows this damage.

The standard magnetic compass which was mounted amidship at frame 75 was apparently damaged during clearance of debris from the vessel. The binnacle was broken at the base, and cables torn in the connection box. The magnetic compass compensating coils in the connection box were loosened from the hanger and adrift. Photographs 1910-11, page 43 and 1910-12, page 42, show this damage.

Recommendations.

Instrumentation data indicates that the alidades were subjected to an air blast of about 23.5 pounds per square inch. It is recommended that the use of cast aluminum for this equipment be completely avoided. In addition the base of the alidade should be strengthened considerably to withstand an air blast.

Instruments mounted in the open should have shatter-proof glass covers.

Instrumentation data indicates that the magnesyn compass was subjected to an air blast of about 25.5 pounds per square inch. It is recommended that the mountings for this equipment be strengthened, and if practicable should be recessed into the superstructure to provide maximum protection against the air blast.

Instrumentation data indicates that the standard magnetic compass was subjected to an air blast of approximately 23 pounds per square inch. It is recommended that the supporting stands for this equipment be strengthened considerably.

P. Sound Powered Telephones.

Although there was some damage to handsets, jack and switch boxes, stowage boxes in the exposed areas on the topside of this vessel, on the whole sound powered telephone equipment stood up reasonably well.

Q. Ship Service Telephones.

No damage.

R. Announcing System.

The general announcing systems on this vessel were generally undamaged and operated satisfactorily, except for the below listed topside reproducers.

The 1MC reproducer on the 01 level port side, was torn from its mounting frame and connection box. The connection box remained intact. The diaphragm was completely torn out and the piece of wood was driven through the side of the reproducer by blast force.

The 1MC reproducer on the superstructure deck, frame 55, was torn loose from its mounting and was blown overboard. The connection box was still intact.

Both damaged 1MC units were manufactured by RCA and were Model M2915-A. They were Class M reproducers.

The 21 MC unit on the open bridge was ripped from its enclosure when its securing screws failed. It was a Type 1 unit manufactured by RCA under Contract NXs-8919. Photograph 1830-7, page 2 , shows this damage.

Recommendations.

Announcing system reproducers installed on the weather deck are extremely vulnerable to the air blast. It is recommended that the reproducers be recessed or preferably faired into the superstructure.

S. Telegraph.

The whistle solenoid was broken from its mounting near the top of the stack, and dropped to the boat deck level. The failure of the cast aluminum enclosures was the cause of this damage.

Recommendations.

Instrumentation data indicates that the whistle solenoid was subjected to an air blast of about 24.5 pounds per square inch. It is recommended that the use of cast aluminum for this type of equipment be discontinued.

T. Indicating System.

No damage.

U. I.C. and A.C.O. Switchboards.

No damage.

V. F.C. Switchboards.

No damage.

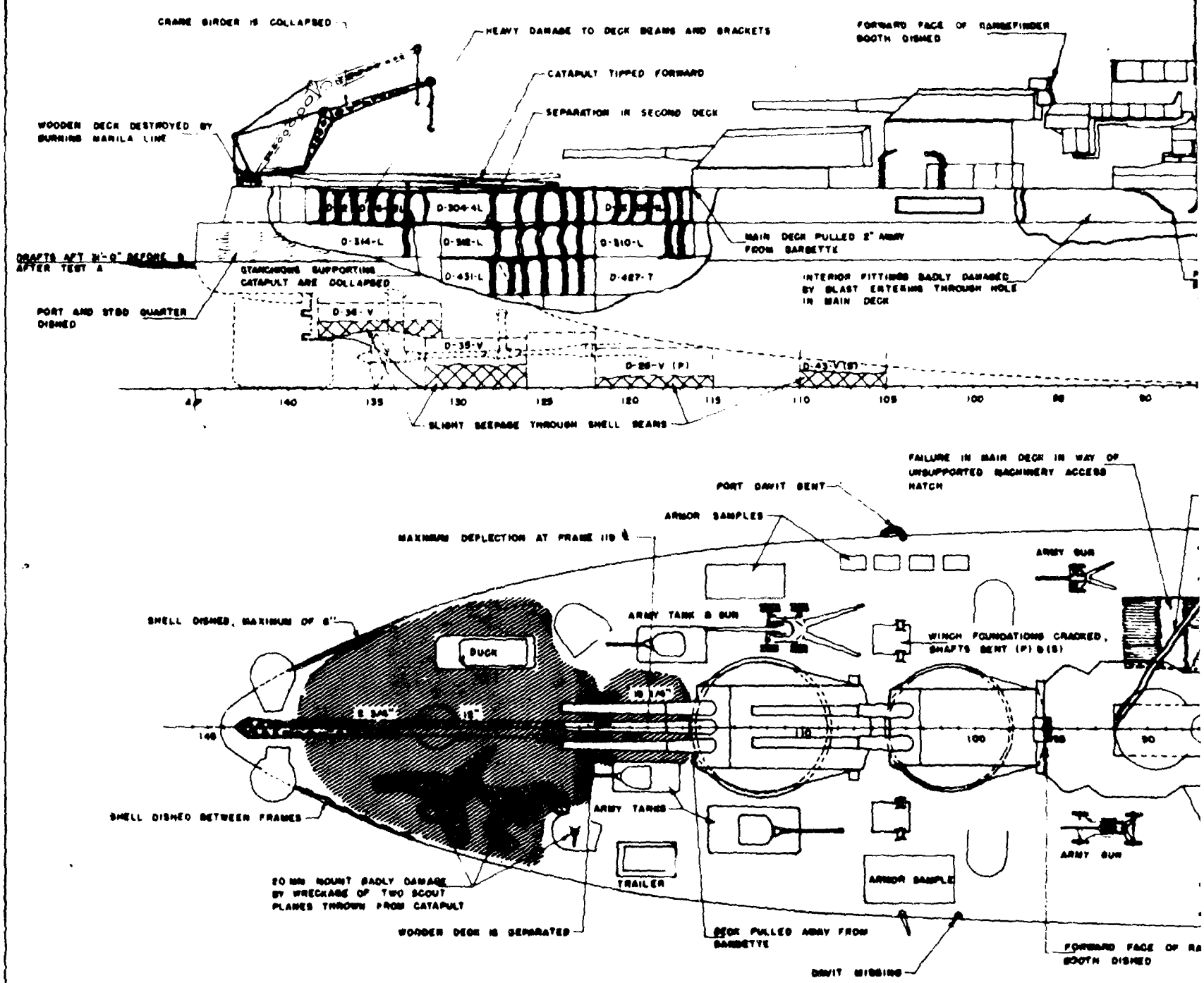
W. Rotary Selector Switches.

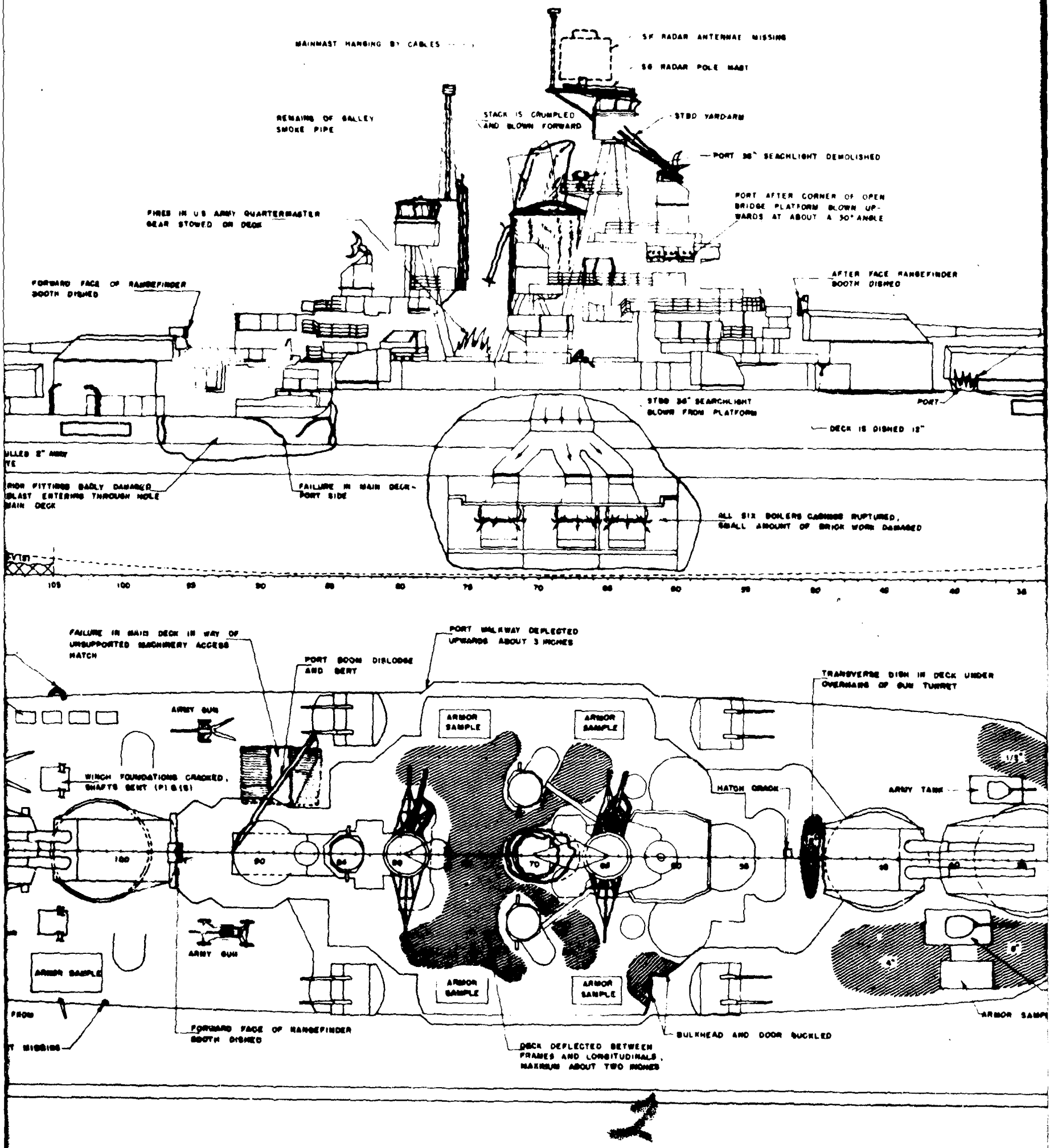
It is interesting to note that although most of the externally mounted rotary selector switches on this vessel were of an obsolete design, they were all operable on the sound powered telephone circuit and the heavy machine gun control circuit.

APPENDIX

SHIP DAMAGE DIAGRAM

TEST ABLE

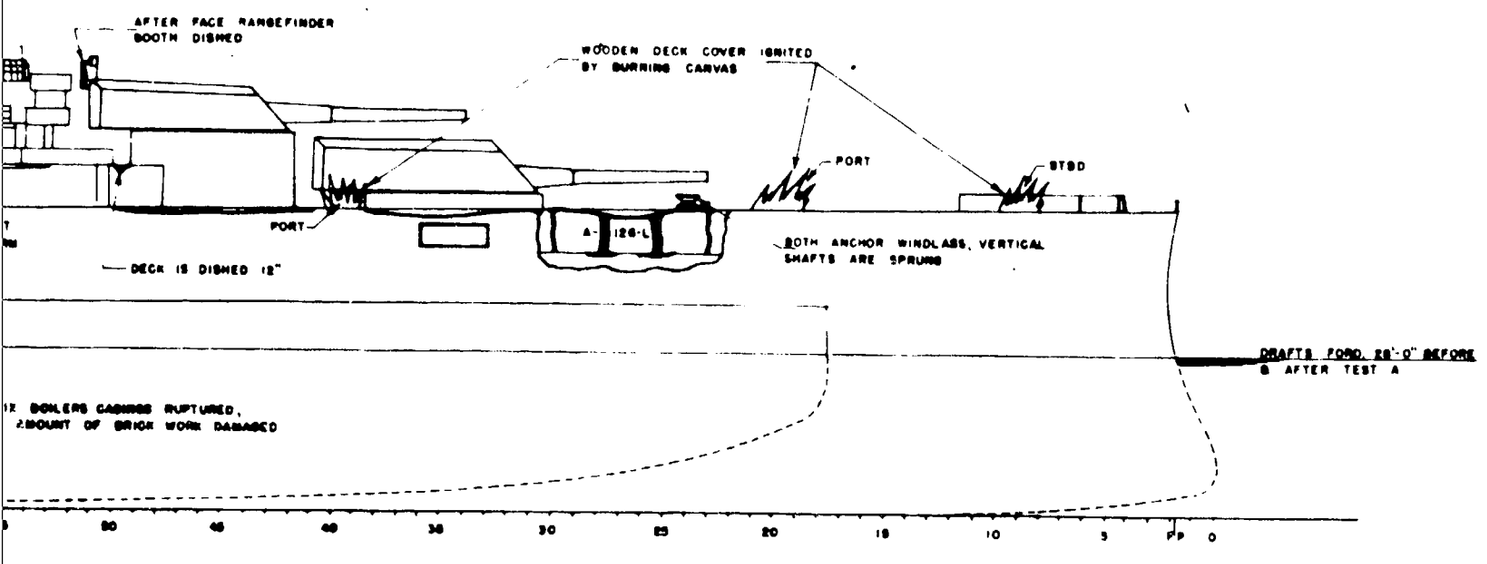

CRANE GIRDER IS COLLAPSED
HEAVY DAMAGE TO DECK BEAMS AND BRACKETS
FORWARD FACE OF RANGEFINDER BOOTH DISHED
CATAPULT TIPPED FORWARD
SEPARATION IN SECOND DECK
WOODEN DECK DESTROYED BY BURNING MANILA LINE
D-304-4L
D-314-L
D-318-L
D-310-L
D-431-L
D-427-T
MAIN DECK PULLED 2" AWAY FROM BARBETTE
DRAFTS AFT 34'-0" BEFORE A AFTER TEST A
STANCHIONS SUPPORTING CATAPULT ARE COLLAPSED
INTERIOR FITTINGS SADLY DAMAGED BY BLAST ENTERING THROUGH HOLE IN MAIN DECK
PORT AND STBD QUARTER DISHED
D-36-V
D-38-V
D-28-V (P)
D-43-V (S)
140
135
130
125
120
115
110
105
100
90
SLIGHT SEEPAGE THROUGH SHELL SEAMS
FAILURE IN MAIN DECK IN WAY OF UNSUPPORTED MACHINERY ACCESS HATCH
PORT DAVIT SENT
ARMOR SAMPLES
MAXIMUM DEFLECTION AT FRAME 119
ARMY GUN
SHELL DISHED, MAXIMUM OF 6"
ARMY TANK & GUN
WINCH FOUNDATIONS CRACKED, SHAFTS BENT (P) & (S)
DUCK
8.5"
15"
16"
140
110
100
90
SHELL DISHED BETWEEN FRAMES
ARMY TANKS
ARMY GUN
20 MM MOUNT BADLY DAMAGE BY WRECKAGE OF TWO SCOUT PLANES THROWN FROM CATAPULT
TRAILER
ARMOR SAMPLE
WOODEN DECK IS SEPARATED
DECK PULLED AWAY FROM BARBETTE
DAVIT MISSING
FORWARD FACE OF RA
BOOTH DISHED

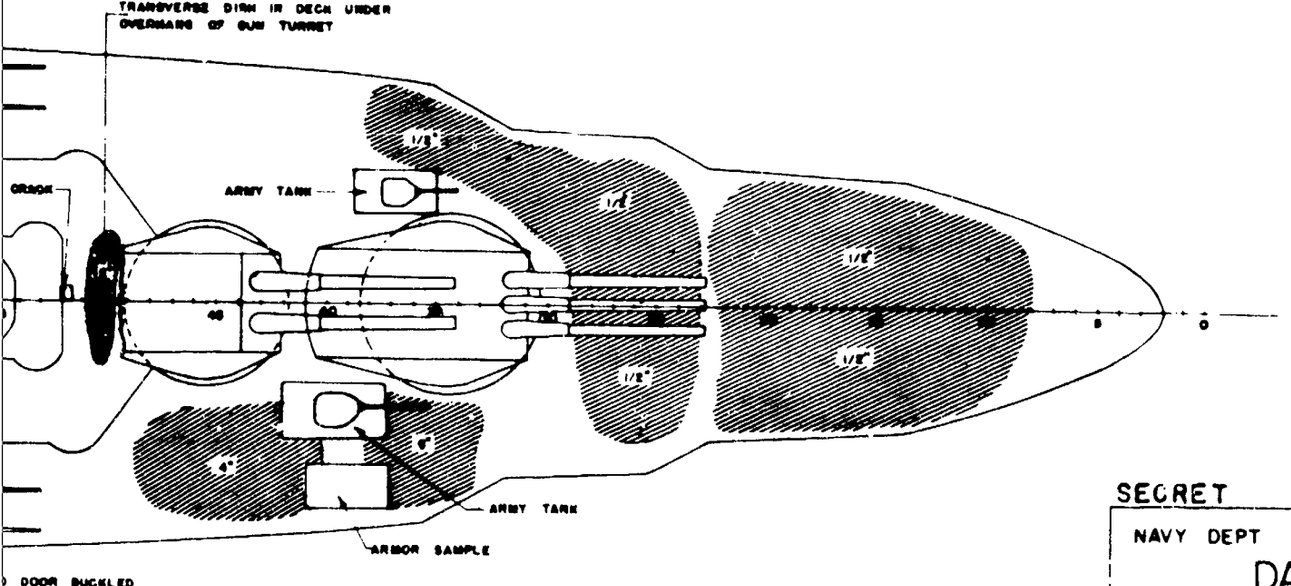

MAINMAST HANGING BY CABLES
SF RADAR ANTENNAE MISSING
SG RADAR POLE MAST
REMAINS OF GALLEY SMOKE PIPE
STACK IS CRUMPLED AND BLOWN FORWARD
STBD YARD-ARM
PORT 36" SEARCHLIGHT DEMOLISHED
PORT AFTER CORNER OF OPEN BRIDGE PLATFORM BLOWN UPWARDS AT ABOUT A 30° ANGLE
FIRES IN U.S. ARMY QUARTERMASTER GEAR STOWED ON DECK
FORWARD FACE OF RANGEFINDER BOOTH DISHED
AFTER FACE RANGEFINDER BOOTH DISHED
STBD 36" SEARCHLIGHT BLOWN FROM PLATFORM
PORT
DECK IS DISHED 12"
FAILURE IN MAIN DECK - PORT SIDE
ALL SIX BOILERS CASINGS RUPTURED, SMALL AMOUNT OF BRIDGE WORK DAMAGED
FAILURE IN MAIN DECK IN WAY OF UNSUPPORTED MACHINERY ACCESS HATCH
PORT BOOM DISLODGED AND BENT
PORT WALKWAY DEFLECTED UPWARDS ABOUT 3 INCHES
TRANSVERSE DISH IN DECK UNDER OVERHANG OF GUN TURRET
ARMY GUN
ARMOR SAMPLE
WINCH FOUNDATIONS CRACKED, SHAFTS BENT (PORT SIDE)
HATCH CRACK
ARMY TANK
FORWARD FACE OF RANGEFINDER BOOTH DISHED
DECK DEFLECTED BETWEEN FRAMES AND LONGITUDINALS, MAXIMUM ABOUT TWO INCHES
BULKHEAD AND DOOR BUCKLED

MISSING

" SEARCHLIGHT DEMOLISHED

RT AFTER CORNER OF OPEN
DGE PLATFORM BLOWN UP-
RDS AT ABOUT A 30° ANGLE





SECRET

NAVY DEPT BUREAU OF SHIPS

DAMAGE
TEST A

USS NEVADA BB 36

APPENDIX

SHIP MEASUREMENT DATA

TEST ABLE

SHIP MEASUREMENT DATA

A. General Considerations.

A deck survey method was developed to determine the twist and longitudinal bending of each target vessel's hull girder resulting from an air or underwater burst of the atomic bomb. The procedure is as follows.

1. Select transverse sections. The maximum number of transverse sections used on any ship was six.
2. At each transverse section, select stations at which rod readings are to be taken. Center punch these stations in the deck. A minimum of five stations were used at each transverse section.
3. Establish throughout the length of the ship, by use of a surveyor's transit, a reference plane approximately parallel to the deck.
4. Take rod readings at every station on each transverse section.
5. Plot rod readings relative to a straight line representing the reference plane.

(a) Readings at each transverse section are plotted in order to obtain the configurations of individual sections and also to establish the relationship between sections.

(b) Readings at desired distances from the centerline are plotted in order to establish sheer lines. On most ships the actual readings are corrected for changes in sections resulting from local damage.

6. Repeat steps 3, 4, and 5 after the test using the stations established in steps 1 and 2.
7. Superimpose the after test plots on the before test plots in order to compare the conditions existing at the times of the two surveys.

The reference planes used in the before test and after test surveys are not necessarily parallel. Their relationship can not be accurately determined because bench marks established before the test may be affected by local damage or by changes in hull alignment.

Therefore it is possible only to determine relative movement of any one section. The reference planes are disregarded after completion of the initial plots.

Twist of the hull girder is determined by superimposing one after test transverse section on the similar before test section and comparing the configurations of the remaining sections. Hog or sag is determined by superimposing before and after test plots of sheer.

The camber curves indicated in all plots are faired lines and do not show local deformation which may exist between the five station points.

B. Measurements.

(1) Deck Survey.

The main deck of the U.S.S. NEVADA was surveyed before and after Test A as outlined in paragraph "A". The superimposed plots of these surveys are shown in figures 6 and 7 on pages 103 and 104 . The before test survey was conducted at Terminal Island Navy Yard on March 19, 1946, and the "After Test Survey" was conducted at Bikini Atoll, July 16, 1946.

Plot of the port, starboard, and centerline sheer lines (figure 6, page 103) indicate negligible longitudinal bending. The small amount of hogging and sagging, one inch maximum, is attributable to local deflections in way of stations selected.

The twist of the ships girder is of very low order and can be considered inconsequential. The plot of the transverse sections shown in figure 7, on page 104 reveals an untrue condition of twist. This condition is probably due to the varying loading conditions between the before and after survey and to local deflections caused by the twist.

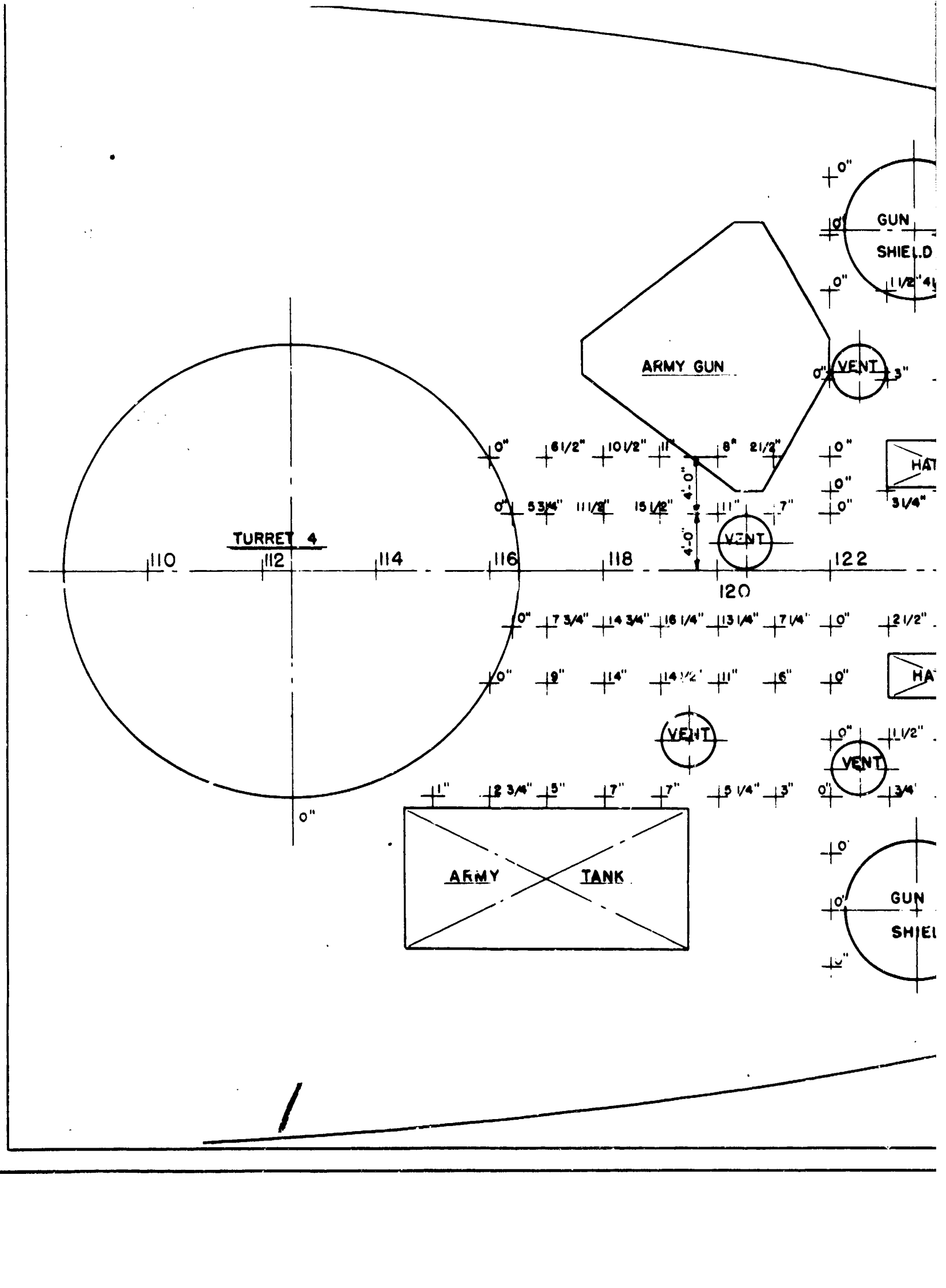
(2) Deck deflection scratch gage data.

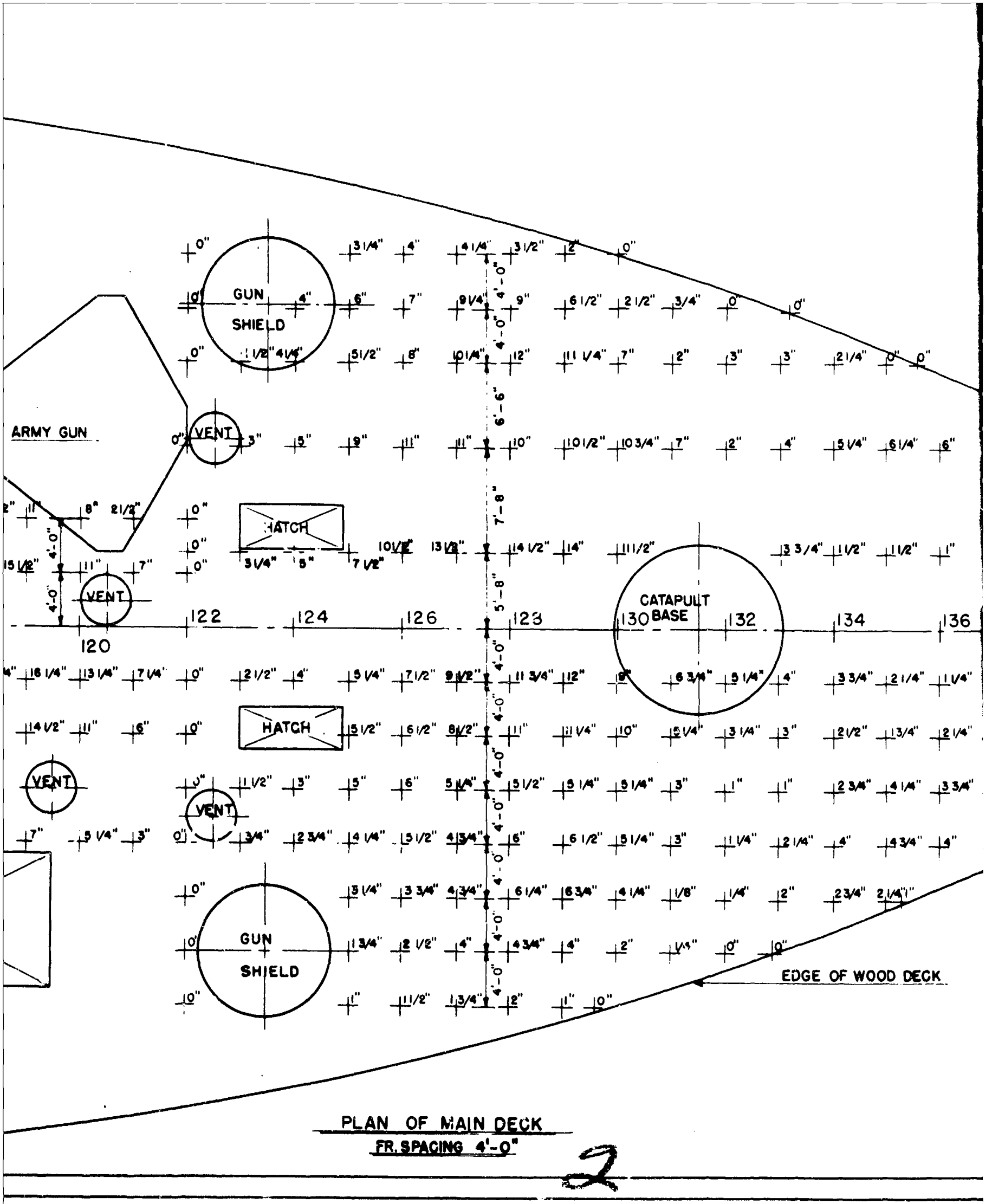
The recordings of gages installed to measure movement

of the weather deck are on figures 8, 9 and 10, pages 105 , 106 , and 107 .

(3) Special measurement of main deck failure.

Because of the marked failure of the main deck aft of turret 4, a special survey was conducted to determine the deflection pattern. The results of this survey are in figure 2, page 99 . Figures 3, 4, and 5,pages 100 , 101 , and 102 , show typical structure in this area.


TURRET 4
110
112
114
116
118
120
122
0"
61/2"
10 1/2"
11"
8"
2 1/2"
0"
0"
5 3/4"
11 1/2"
15 1/2"
11"
7"
0"
4'-0"
4'-0"
ARMY GUN
VENT
3"
GUN
SHIELD
11/2"
HAT
3 1/4"
0"
7 3/4"
14 3/4"
18 1/4"
13 1/4"
7 1/4"
0"
2 1/2"
0"
9"
14"
14 1/2"
11"
6"
0"
HA
VENT
VENT
0"
1 1/2"
3/4"
1"
2 3/4"
5"
7"
7"
5 1/4"
3"
0"
ARMY
TANK
0"
GUN
SHIEL



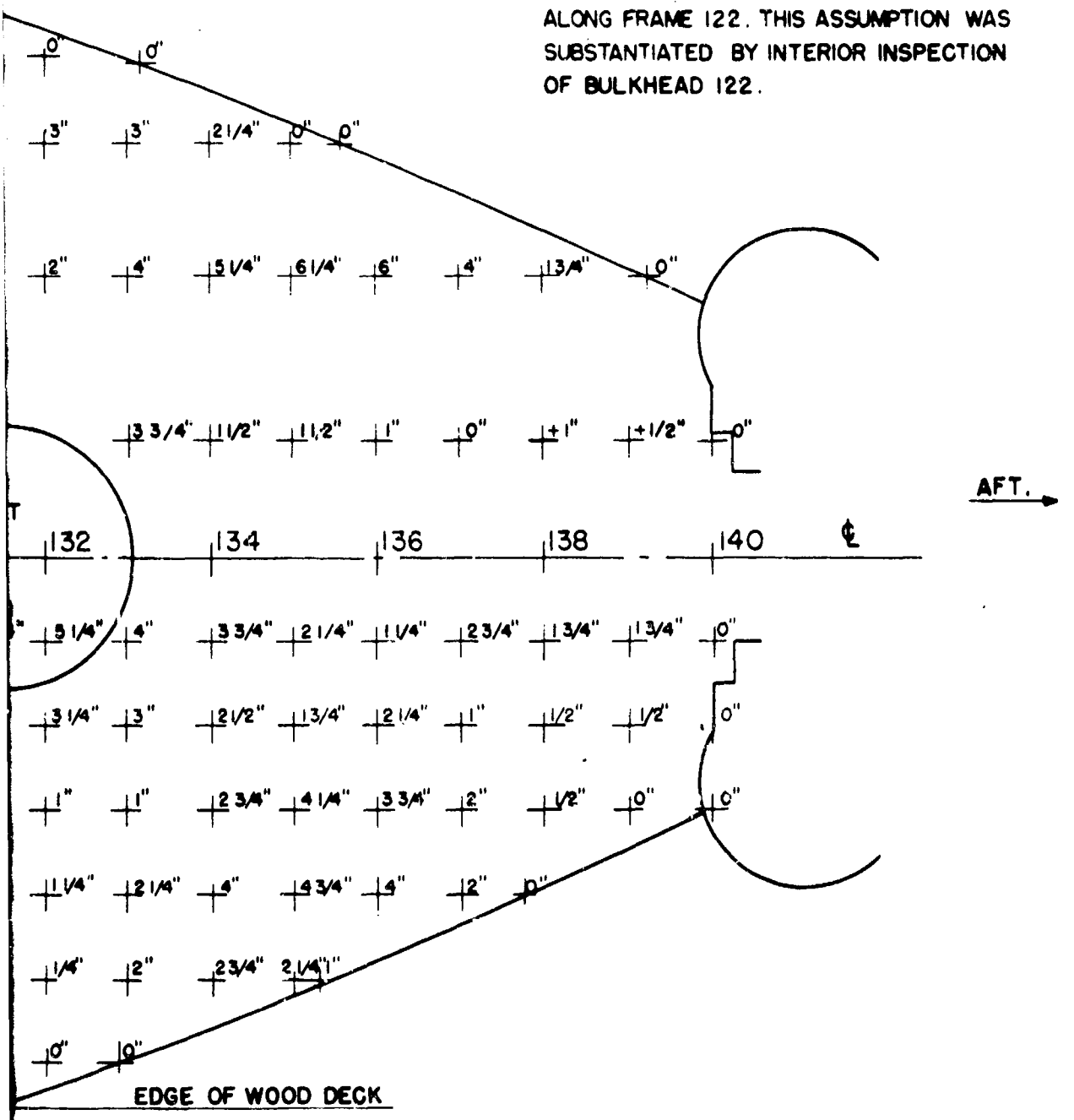
PLAN OF MAIN DECK

FR. SPACING 4'-0"

2

NOTE:

FOR THE PURPOSE OF OBTAINING THESE MEASUREMENT IT WAS NECESSARY TO ASSUME THAT THE DECK DID NOT DEFLECT ALONG FRAME 122. THIS ASSUMPTION WAS SUBSTANTIATED BY INTERIOR INSPECTION OF BULKHEAD 122.



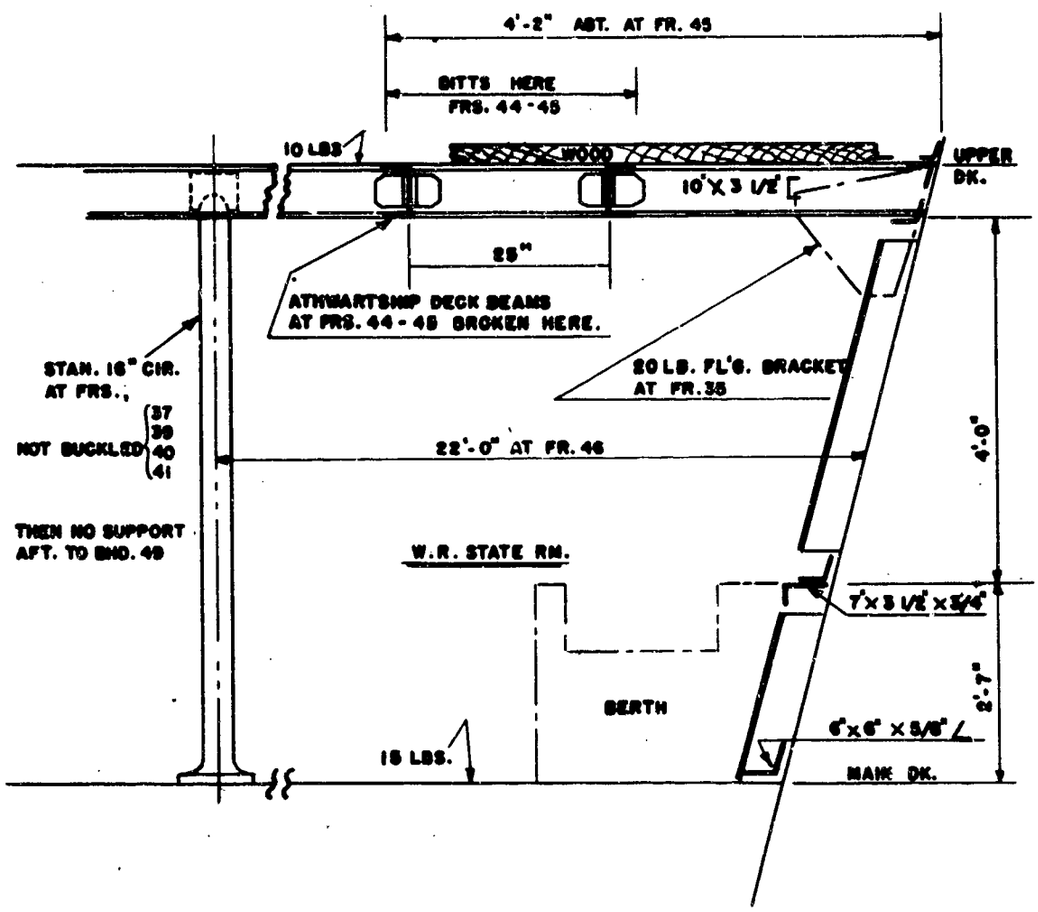
SECRET

NAVY DEPT. BUREAU OF SHIPS

DECK DEFLECTIONS

U.S.S NEVADA BB 36

FIGURE NO. 2



TYPICAL SECTION STB'D SIDE LOOKING FWD.
IN WAY OF SEVERE DISHING OF UPPER DECK
AT FRS. 35 AND 45.

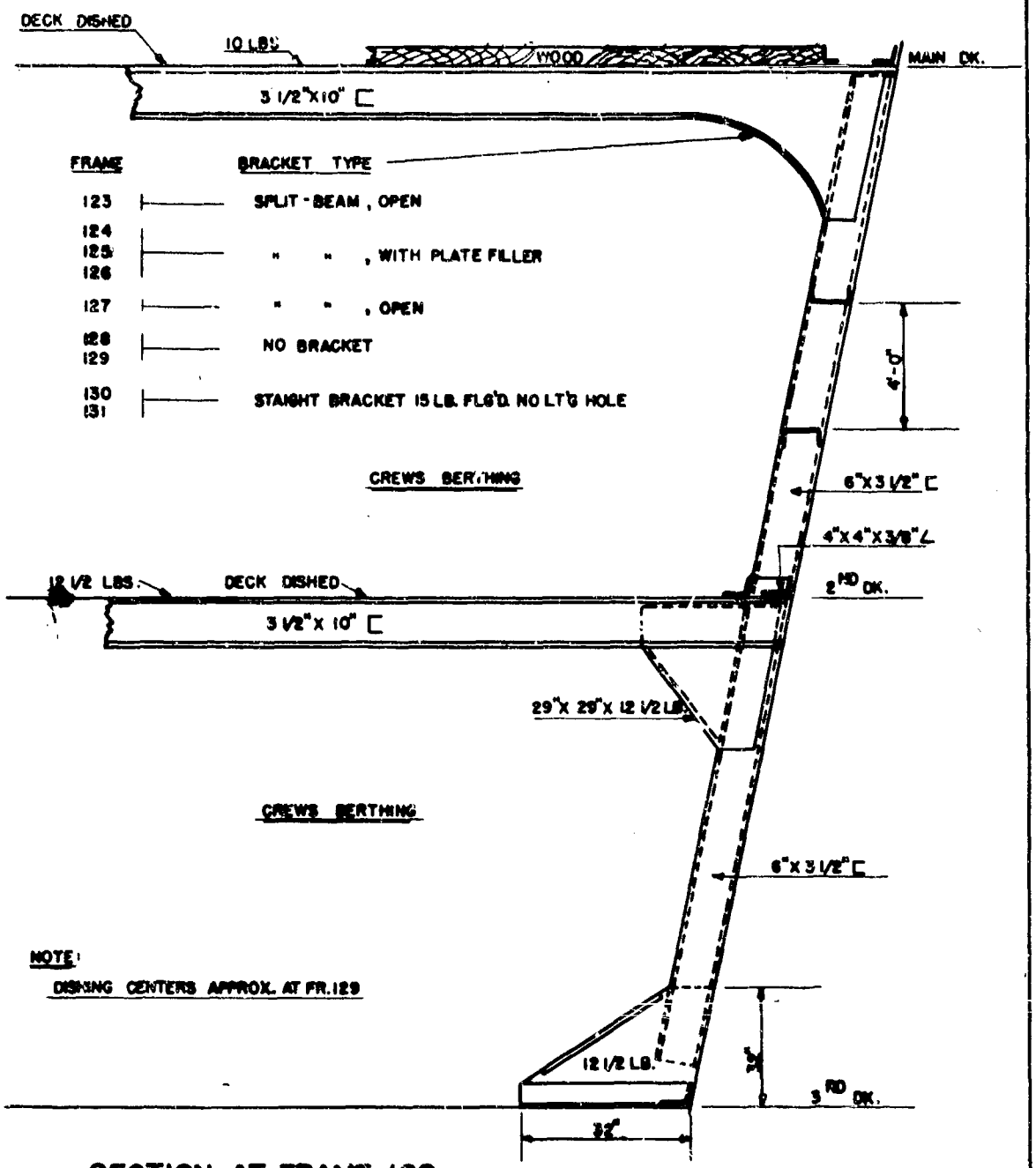
SECRET

NAVY DEPT. BUREAU OF SHIPS

TYPICAL SECTION

U.S.S NEVADA BB 36

FIGURE NO.3 9795



SECTION AT FRAME 128
STB'D SIDE LOOKING FORWARD

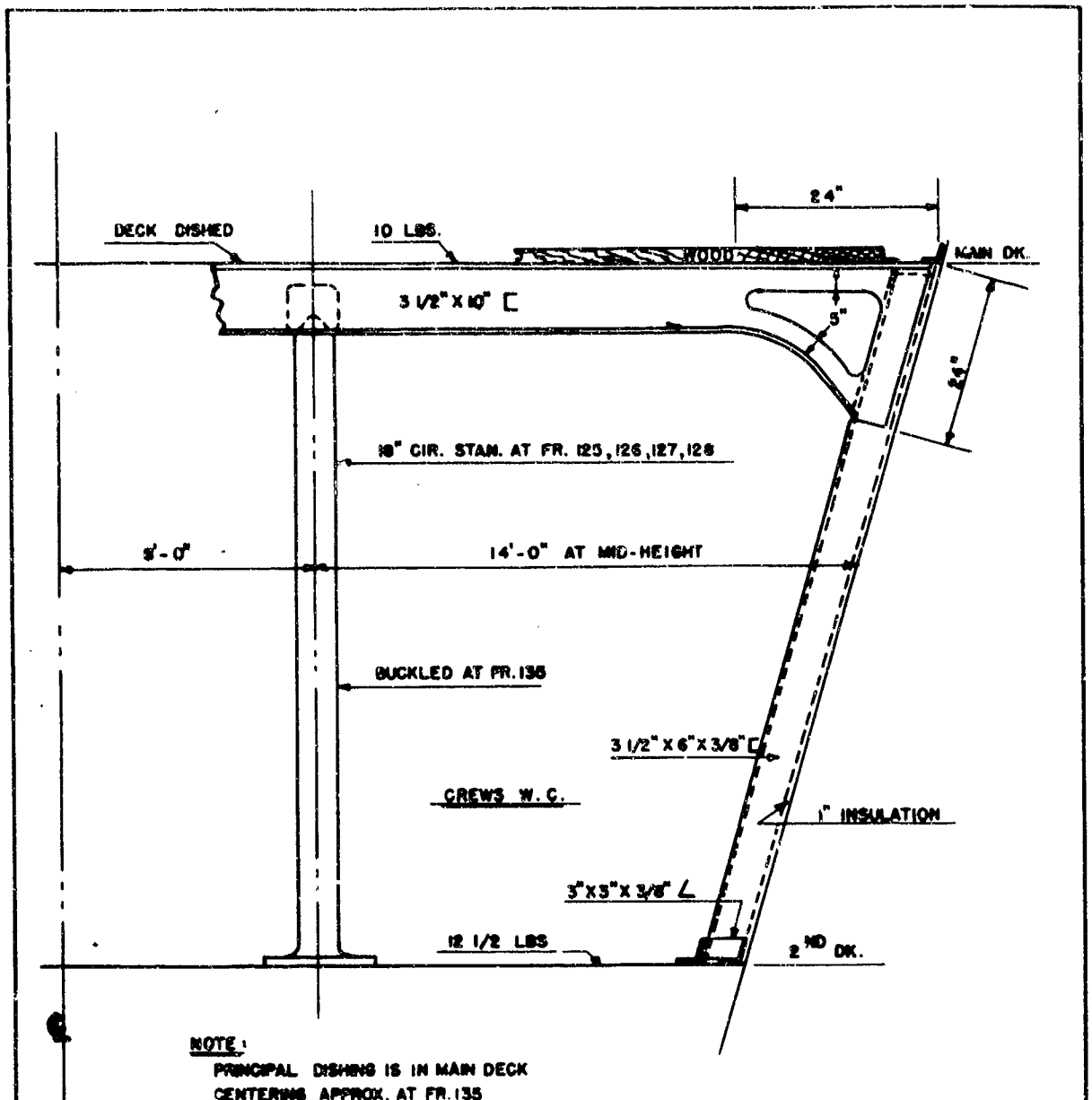
SECRET

NAVY DEPT. BUREAU OF SHIPS

TYPICAL SECTION

U.S.S. NEVADA BB 36

9795



NOTE:
PRINCIPAL DISHING IS IN MAIN DECK
CENTERING APPROX. AT FR. 135

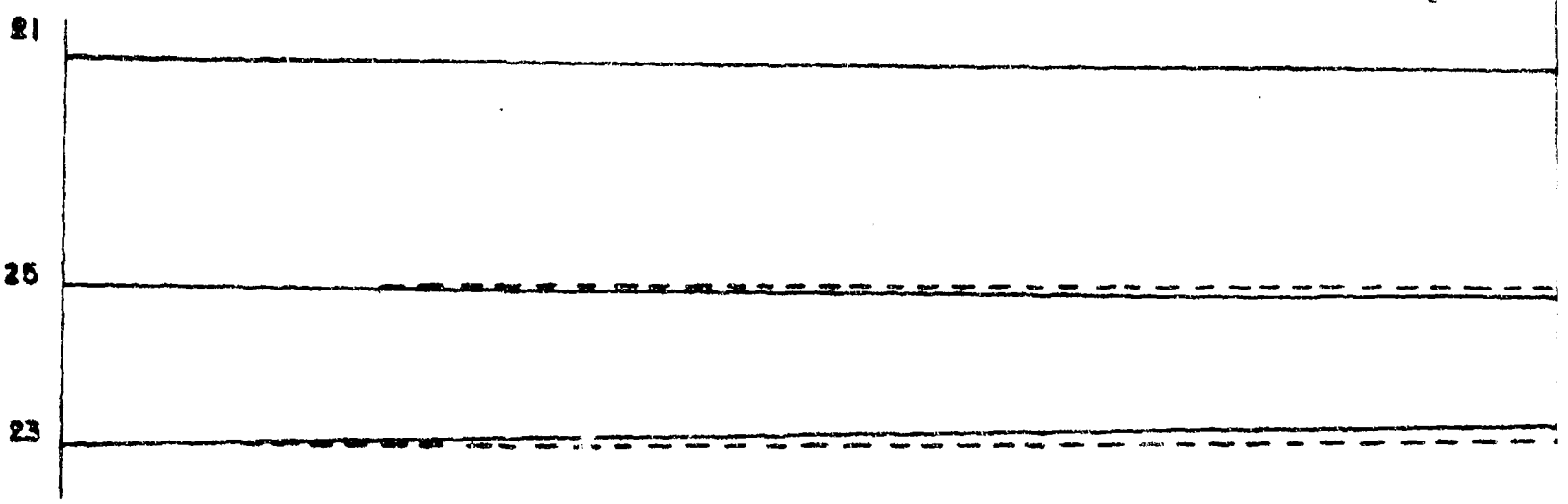
SECTION AT FRAME 135
STB'D SIDE LOOKING FWD.

SECRET

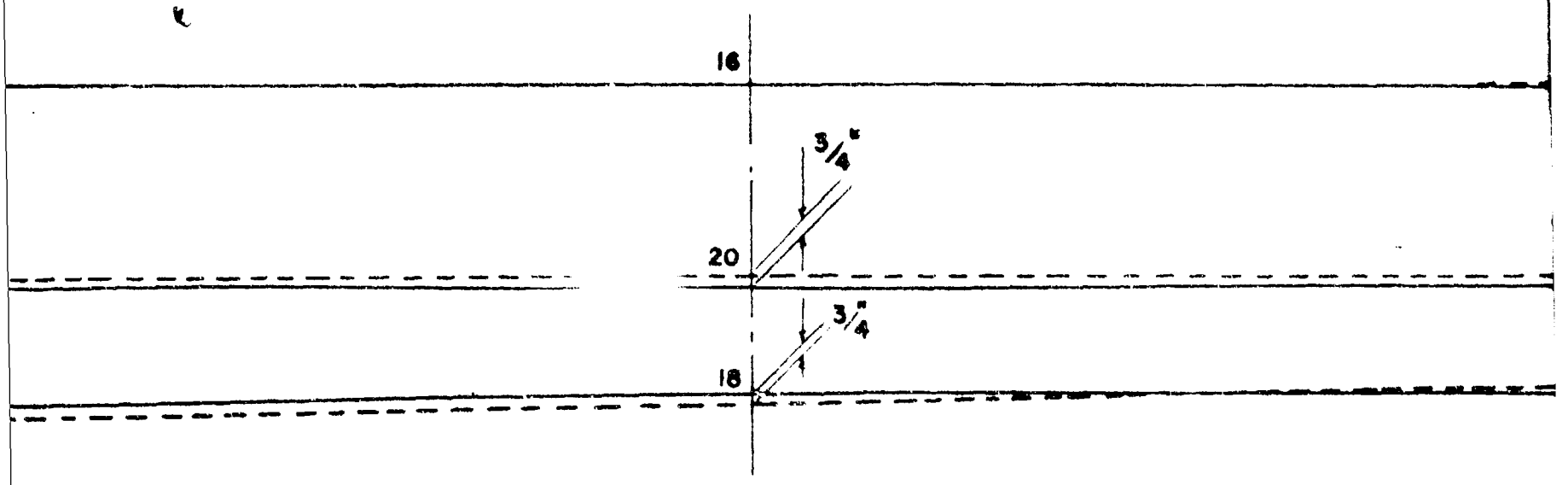
NAVY DEPT. BUREAU OF SHIPS

TYPICAL SECTION

U.S.S. NEVADA BB 36

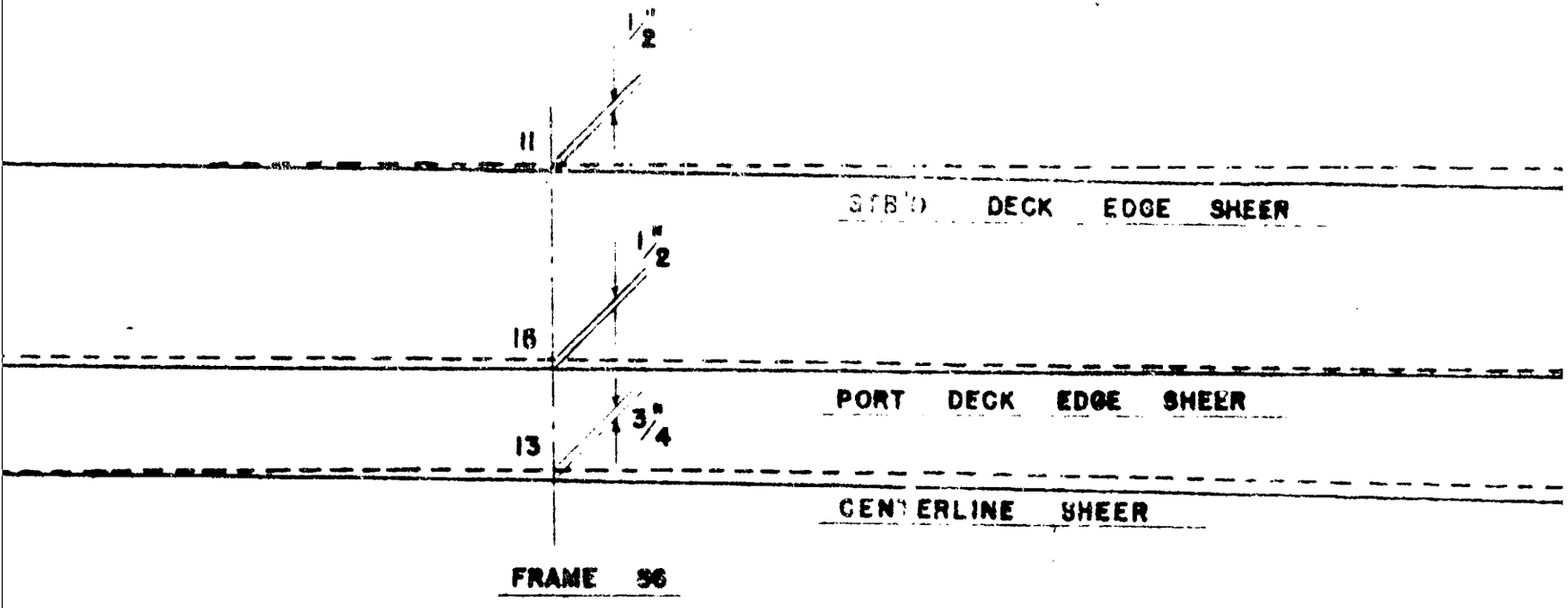


FRAME 122

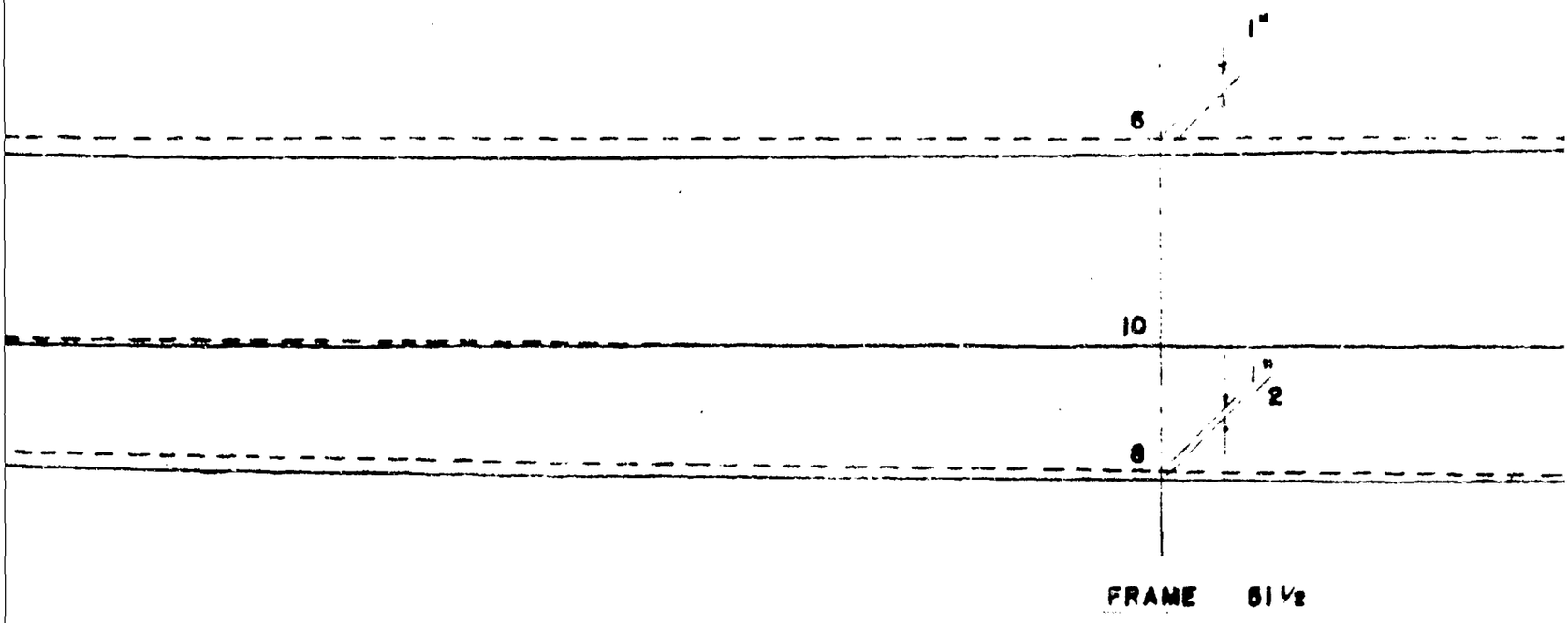


FRAME 96

2



SHEER LINES - PROFILES



FRAME 61 ½

1"

1

5

1"

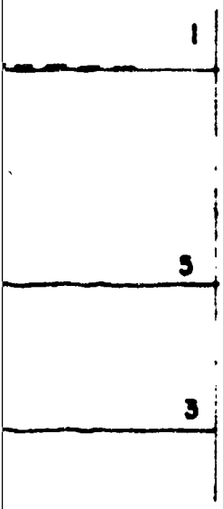
1/2

3

81 1/2

FRAME 2

5



FRAME 29

——————— BEFORE TEST

— — — — — — — AFTER TEST

6

SECRET

NAVY DEPT. BUREAU OF SHIPS

DECK SURVEY
TEST A

U.S.S. NEVADA BB 36

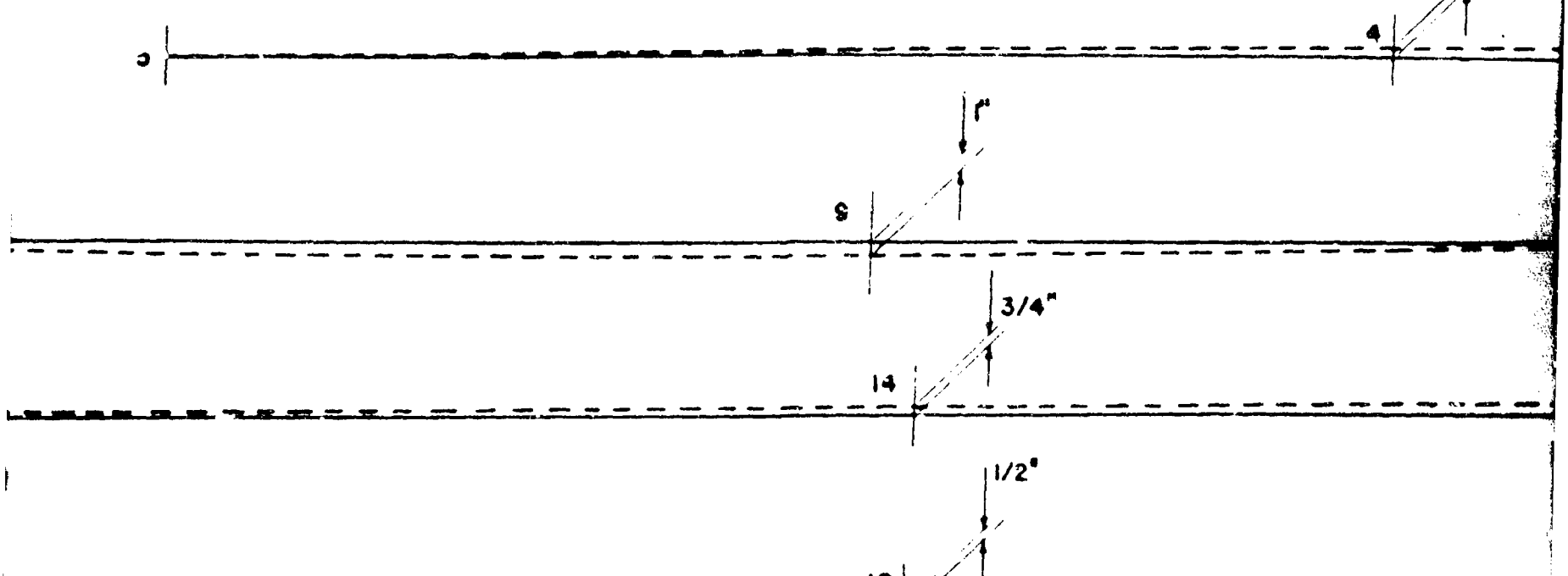
5

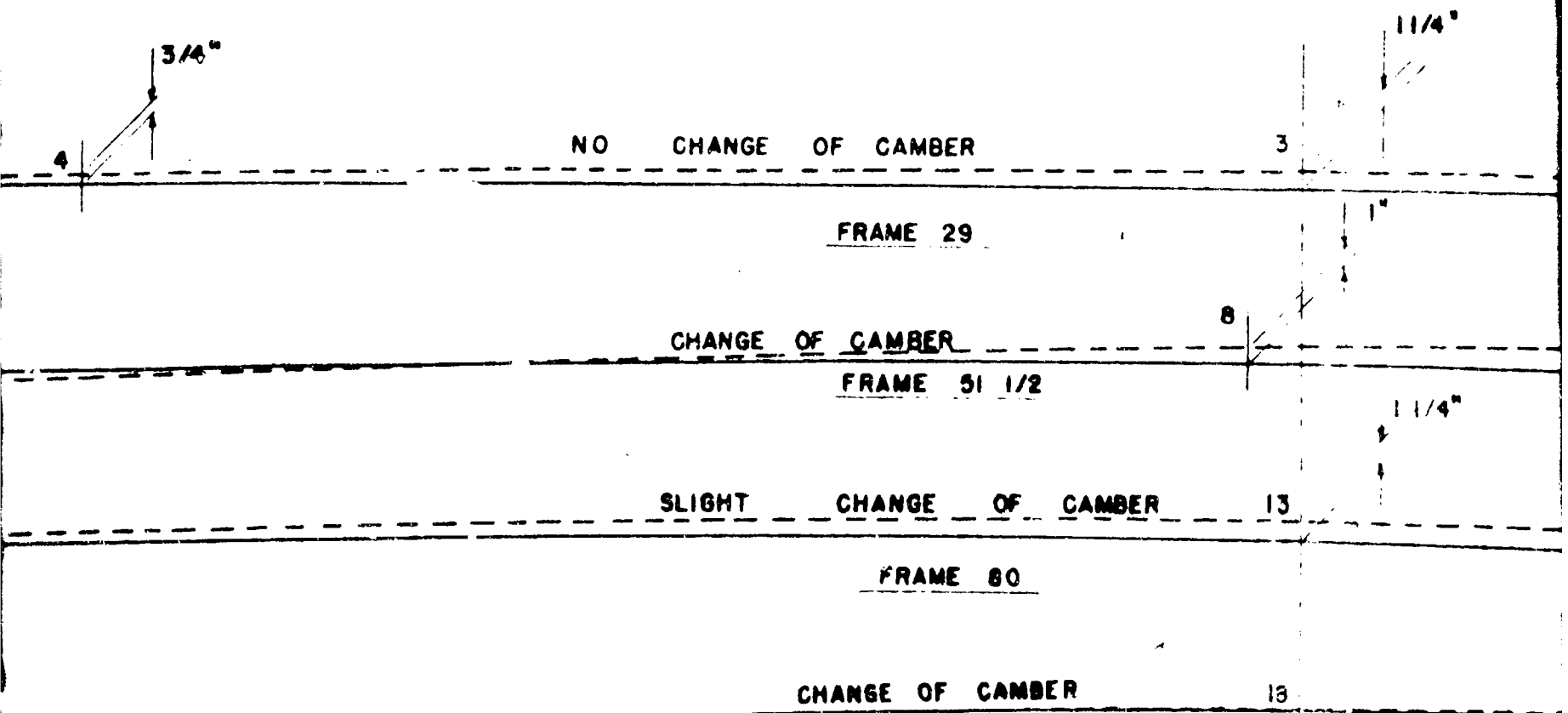
10

15

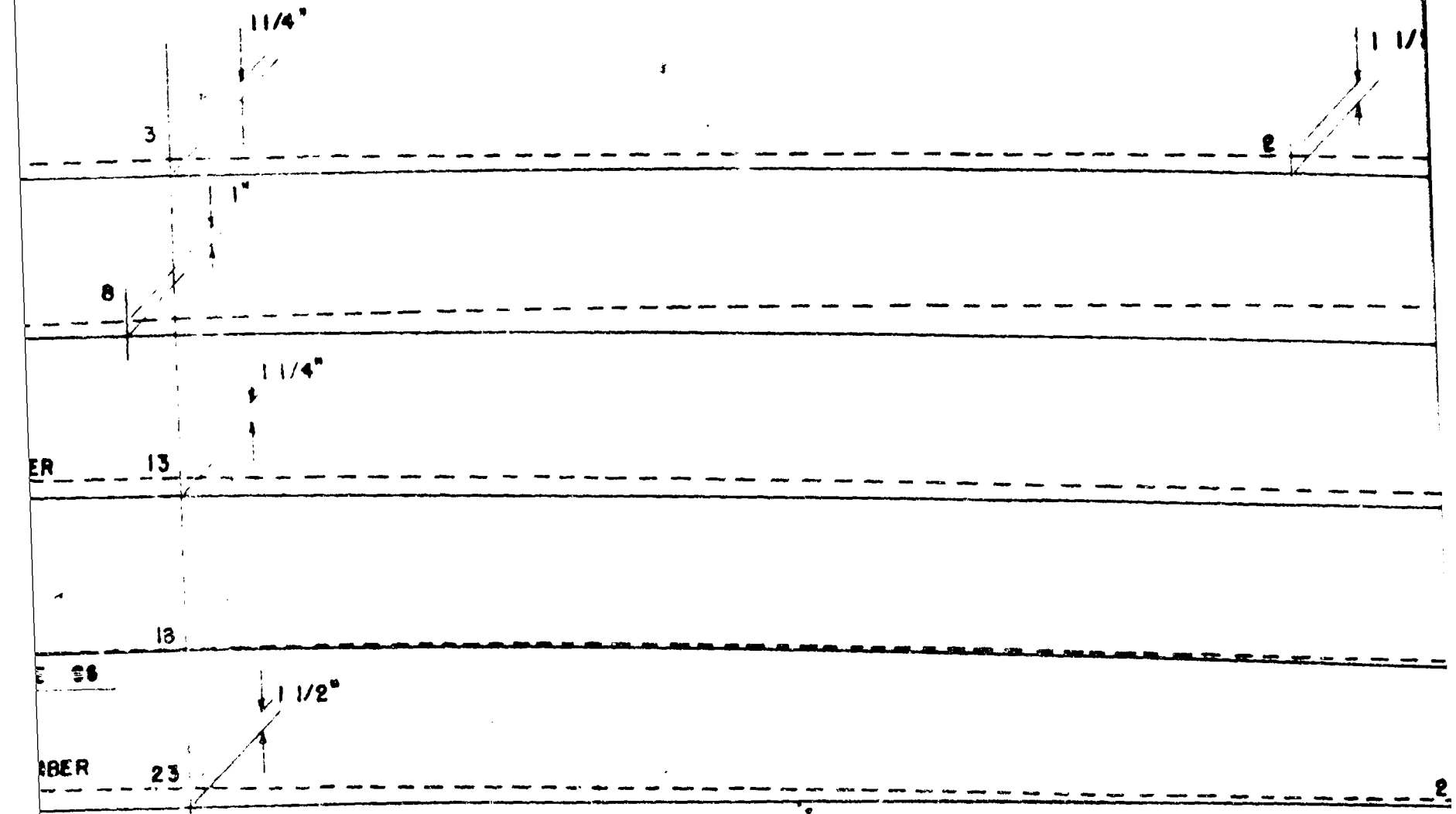
20

25

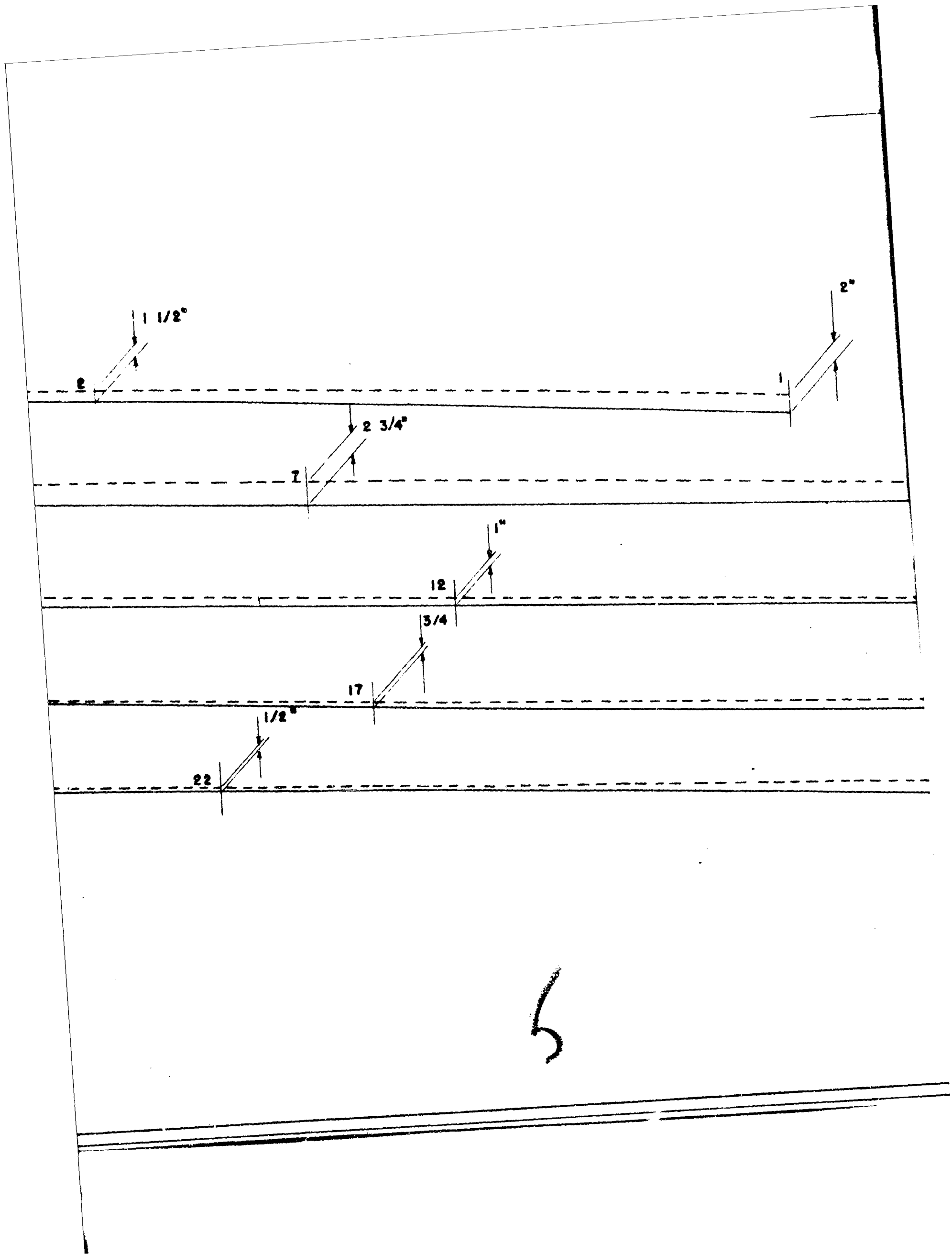

3/4"
4
1"
8
3/4"
14
1/2"
18
1"
24

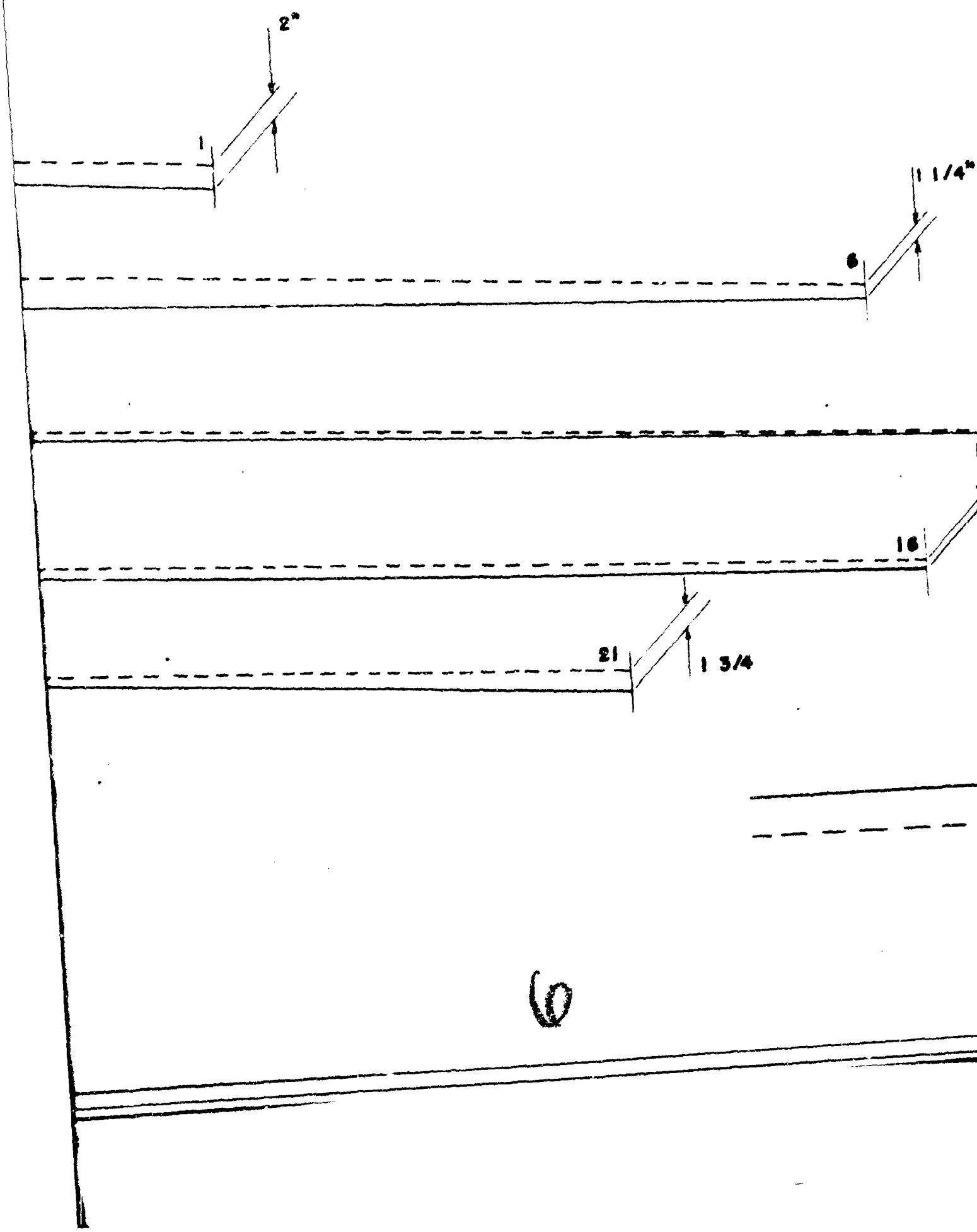


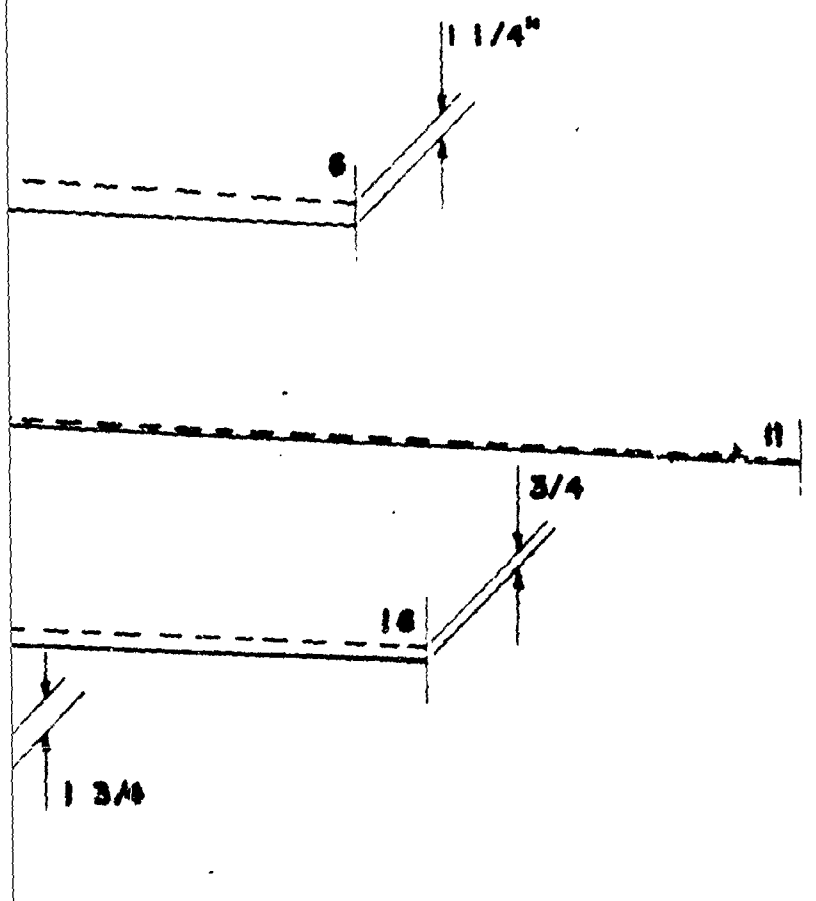
TRANSVERSE SECTIONS -- LOOKIN



ECTIONS --- LOOKING FWD.


1 1/2"
2"
2 3/4"
1"
3/4
1/2"
2
1
I
12
17
22


2"
1
1 1/4"
6
11
3/4
16
21
1 3/4
BEFORE TEST
AFTER TEST



_____ BEFORE TEST

_ _ _ _ _ _ _ _ AFTER TEST

1

SECRET

NAVY DEPT. BUREAU SHIPS

DECK SURVEY
TEST A

U.S.S. NEVADA BB 36

FRAME NO.7 PAGE 104 OF 153 3705

SECRET

DECK DEFLECTION GAGES

SHIP USS NEVADA (BB-36) **TEST** A

LOCATION			MAXIMUM	MAXIMUM	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄	COMP.	EXP.	DISTANCE	EXP./COMP.	
5	Main,	Centerline	0-0-3/8	None	0-0-1/4	Comp.	None
40	"	Port	0-0-1/4	0-0-3/16	0-0-1/16	Comp.	None
40	"	Centerline	0-4-5/8	0-0-1/4	0-1-3/4	Comp.	Tublar pipe bent indicating sag in ship
41	"	Stbd	0-1-3/4	None	0-0-15/16	Comp.	Tublar pipe bent indicating sag in ship
91	2nd	Port					Destroyed by local conditions
91	"	Stbd	None	None	None	None	None
107	"	Port	0-1-1/8	None	0-0-5/8	Comp.	None
107	"	Stbd	0-0-1/8	None	None	None	None
119	"	Port	0-4-5/16	None	0-3-1/4	Comp.	None
119	"	Centerline	1-8-5/16	0-0-1/4	1-3-0	Comp.	

U.S.S. NEVADA (BB-36)

FIGURE NO. 8
PAGE 105 OF 153

9795

SECRET

DECK DEFLECTION GAGES

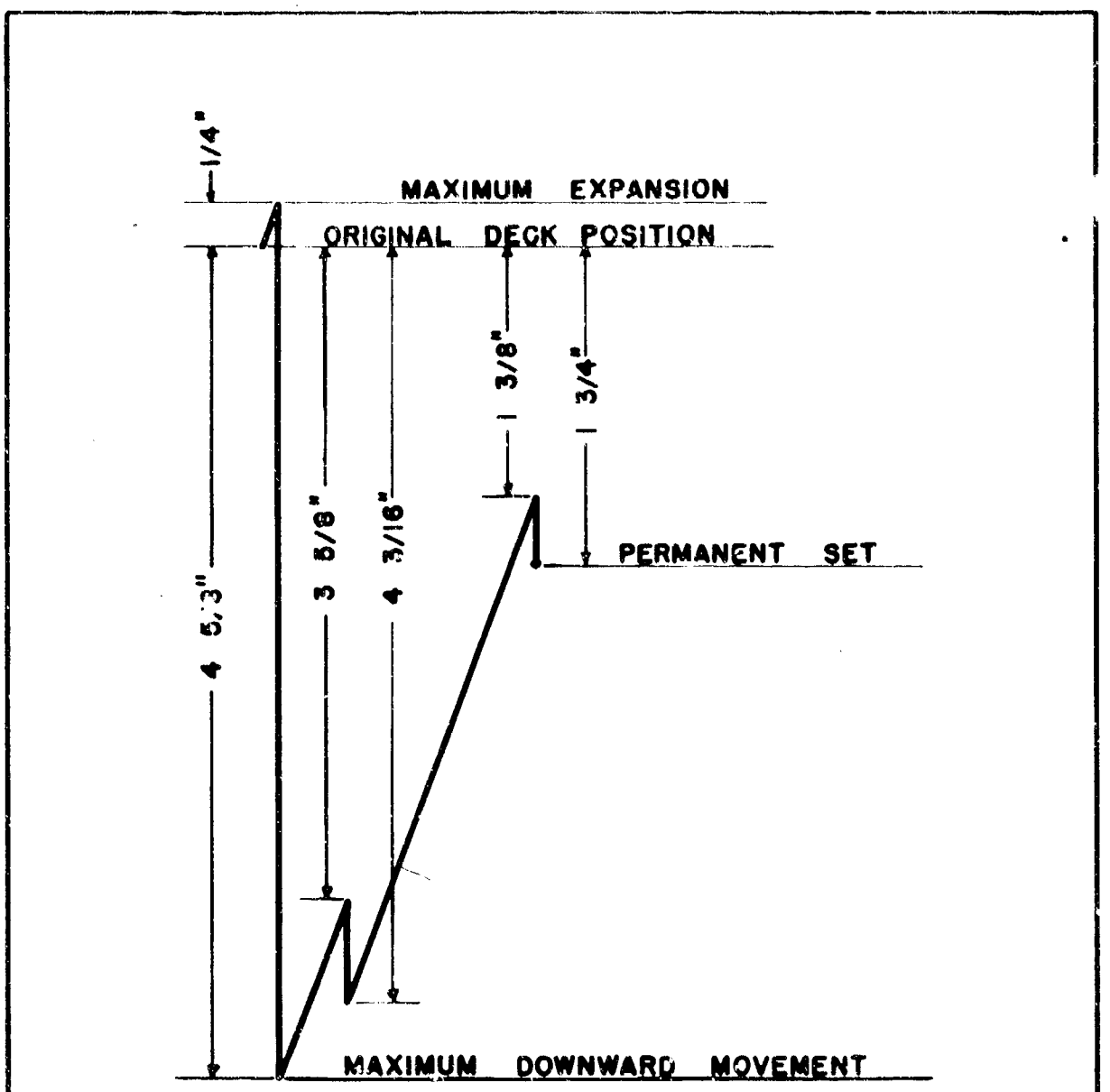
SHIP USS NEVADA (BB-36) **TEST** A

LOCATION			MAXIMUM COMP.	MAXIMUM EXP.	PERMANENT SET		REMARKS
FR. NO.	DECK	DIST. OFF ℄			DISTANCE	EXP. / COMP.	
119	2nd	Stbd	0-1-3/8	None	0-1-1/8	Comp.	Due to local conditions

U.S.S. NEVADA (BB-36)

FIGURE NO. 9
PAGE 106 OF 183

9795



ALL MOVEMENTS VERTICAL,
LINES SLANTED FOR CLARITY.

TEST "A"
SCRATCH GAGE RECORD, FR. 40 CENTER LINE
RELATIVE MOVEMENT OF FOLSLE AND MAIN DECK.

SECRET U.S.S. NEVADA BB 36

FIGURE NO. 10

9795

APPENDIX

COMMANDING OFFICER'S REPORT

TEST ABLE

SECTION III

PART C - INSPECTION REPORT

SECTION A - HULL

A. General Description of Hull Damage.

(a) Overall condition of vessel.

The overall condition of vessel was good. No damage to the hull except minor dishing in port and starboard quarters and main deck aft.

(b) General areas of hull damage.

Port quarter, starboard quarter and starboard upper deck.

(c) Apparent causes of hull damage in each area.

Pressure.

(d) Principal areas of flooding with sources.

Deadwood area, D-35-V, D-36-V, flooded from the sea (apparent seam seepage).

(e) Residual strength, buoyancy and effect of general condition of hull on operability.

Residual strength very good. No change to bucyancy.

B. Superstructure (exclusive of gun mounts).

(a) Description of damage giving important dimenstions.

1. Pressure damage to wings of bridge, dishing of doors on port side and serious wracking of all joiner work in area.

After side of bridge structural bulkheads received pressure damage. Ladders to signal bridge from boat deck were blown down. Starboard yardarm on foremast carried away. No damage to pilot house (goats and rats in pilot house apparently unaffected by heat and pressure, no report as to radiological effects). Blast reflected from foremast and dished forward side counter radar measure house on signal bridge level.

2. Midship deckhouse and stacks.

Stack practically demolished by pressure and couldn't be used until the top was cut off.

3. After deck and tower.

The after deck house and tower were dished on port and after sides. The door to optical shop on starboard side were demolished.

(b) Causes of damage in each area.

Damage in each area was due to blast and pressure.

(c) Evidences of fire in superstructure.

Only fire in superstructure area was from Army Quartermaster gear lashed to boat deck.

(d) Estimate of relative effectiveness against heat and blast of:

All structural thicknesses seemed to withstand heat and blast quite well. Shape had little or no effect on damage resulting (curved stack was crushed while square clipping rooms were not damaged). However, all joiner work was badly damaged in superstructure area. STS withstood the blast a little better than MS. Aluminum mounts on radars and 36'' searchlights carried away.

(e) Constructive criticism.

Pockets where large vertical and horizontal surfaces

intersect at right angles concentrate the force. An attempt should be made to streamline superstructure areas and eliminate such spaces.

C. Turrets, Guns and Directors.

(a) Protected Mounts.

1. The general condition, including operability, if known. All protected mounts operated satisfactorily after test A and were capable of remaining in action. This includes both main and secondary battery.

2. The effectiveness of installed turrets and shields in the above mounts is excellent.

(b) Unprotected Mounts.

1. The general condition of the unprotected mounts, 40 and 20mm batteries was very good, only 1 20mm mount was totally disabled, and this was due to being destroyed by plane being blown against it. As for material condition, all other mounts would have been serviceable for tracer fire. (Power for serviceable Mk. 14 sights would have been lost temporarily due to boiler damage).

2. Little or no protection is provided for crews.

(c) Directors and Rangefinders.

The protected directors, both main and secondary batteries are in good condition and would have remained in service it is believed. The exposed directors, main battery director in Spot II and Mark 57 director on 40mm controls were damaged and unserviceable. The main battery rangefinders in turrets (coincidence) 5'' rangefinders (Stero) in Mk. 37 director revealed only minor damage and remained operable. The instruments in all enclosed directors showed no signs of damage.

(d) Constructive Criticism.

Judging by the excellent resistance to the heat and pressure, the mounts, turrets, enclosed directors and foundations

on this vessel, little improvement in design is necessary. However, this may be disproved if it was possible to completely align this ships battery. All antiaircraft guns should be covered with light armor to protect personnel from the heat and blast.

D. Torpedo Mounts, Depth Charge Gear.

Not applicable.

E. Weather Deck.

(a) General condition of deck and causes of damage.

Forecastle deck in fair condition, had been pushed down about two inches in some areas. Main deck aft suffered from pressure and failure of frames and stanchions at machinery hatch. Main deck from turret IV aft suffered the worst, showing indications of extreme dishing due to pressure. Stanchions failed and allowed deck to ripple between structural bulkheads which held fairly well.

(b) Useability of deck in damaged condition.

Deck completely useable except where actually collapsed aft of frame 86, port side.

(c) Condition of equipment and fittings.

1. All cleats and bits in good condition. Mooring and towing fittings undamaged.

2. Boats and boat handling.

Boat boom blown up to Quad eight mount. Not useable. Port gangway demolished. One gangway davit on starboard side blown overboard. Liferafts broken and missing, only three in good condition.

3. Airplane handling gear.

Catapult foundation failed, therefore, catapult

would not be useable. Stern crane bridgework failed, crane machinery was not damaged. Crane cannot be used. Airplane handling boom undamaged.

F. Exterior Hull (above waterline).

(a) Condition of exterior hull plating and causes of damage.

Exterior hull plating received no damage except slight dishing on port quarter and very slight dishing on starboard quarter.

(b) Condition of exterior hull fittings and causes of damage.

No damage to exterior hull fittings except gangway davit on port side out of commission due to blast and one starboard davit blown overboard.

(c) Details of any impairment of shear strakes.

No damage to shear strakes.

(d) Condition of side armor belt, if fitted externally.

No damage to side armor belt.

G. Interior Compartments (above waterline or armor deck if fitted).

(a) Damage to structure and causes.

Damage consist mainly of bulged and dished bulkheads, bent stanchions and uprights. All damage caused by pressure from topside on the weather deck. Deck beam at frame 50 in Sick Bay broken about 15 feet from port side. Top of Sick Bay dished in between this frame and .02 level. It is believed this dishing was due to the pressure wave striking the rear of gun turret number two and being reflected to the deck.

(b) Damage to joiner bulkheads and causes.

Joiner bulkheads damaged extensively by pressure from above.

(c) Details of damage to access closures and fittings.

Some doors and hatches were dished in by pressure. Ports in shipfitters shop blown in but no ports in the hull were damaged.

(d) Condition of equipment within compartments.

All equipment within compartments in operable condition.

(e) Evidence of fire.

Only evidence of fire was in the port and starboard steam table which was due to fire above in Army Quartermaster gear.

(f) Damage in way of piping, cables, ventilation ducts, etc.

Piping damage caused by distortion of bulkheads, frames and decks. Firemain branch lines damaged, main loops untouched. Ventilation ducts were blown down due to pressure within duct and distortion of bulkheads.

(g) Extimate of reduction in watertight subdivision, habitability and utility of compartments.

Although there was no actual flooding, the watertight integrity of the hull was jeopardized by: (1) The 20' square hole blown through the main deck frame 86 - 91, port side and (2) The wide crack around the after edge of turret IV where the deck pulled away from the barbette.

Water entering through sources; (1) above would have flooded C-291-1L directly and C-291-2L, C-291-3L and D-201-4L through watertight doors damaged by the blast. Water

entering through source (2) above would have flooded D-203-1L directly and D-203-4L, D-206-2L, D-312-L and D-314-L through damaged seams and small holes around vents and wiring stuffing tubes.

Utility of compartments from frame 64 to 96 on main and upper deck about 50%. Compartments on second deck from frame 86 to stern, about 50%.

H. Armor Deck.

(a) Damage to armor deck and acuses of damage.

Slight dish in armored deck above machine shop due to pressure on stanchion from above.

(b) Protection afforded spaces below.

Protection afforeded by armored deck to spaces below very good.

(c) Condition around openings.

All armored hatches and spaces around them undamaged. Hatches in good condition, gratings in good condition, uptake bulkheads in good condition, only damage around barbettes was due to deck plating splitting away. Barbettes themselves undamaged.

(d) Condition of connections to vertical armor.

No evidence of damage to connections between vertical and horizontal armor.

I. Interior Compartments (below waterline).

(a) Damage to structure and causes.

D-212-L overhead bulged and stanchions buckled. One stancion in machine shop slightly bent. Frames in after part of the ship where not protected by armored deck bent due to pressure from topside.

(b) Damage to joiner bulkheads and causes.

Some joiner bulkheads distorted due to pressure from topside.

(c) Details of damage to access closures and causes.

There was no damage to doors. A few hatches were dished and sprung due to pressure. None not useable.

(d) Condition of equipment within compartments.

Equipment within compartments in good condition.

(e) Flooding.

Slight flooding or seepage from the seams in D-35-v and D-36-v.

(f) Damage in way of piping, cables, ventilation ducts, shafts, etc.

Slight damage to ventilation ducts due to blast pressure through the vents themselves. Damage to piping and cables due to bulkhead and deck distortion. There was little damage to any cables or piping below waterline however.

(g) Estimate of reduction in watertight subdivision, habitability and utility of spaces.

Reduction of these items below the waterline due to the bomb test was very small.

J. Underwater Hull.

(a) Interior inspection of underwater hull.

From all appearances, the underwater hull body suffered no damage.

(b) Effect of damage on buoyancy, operability, maneuverability.

No damage to buoyancy, operability or maneuverability, so far located or expected.

(c) Any known or suspected damage to: Shafts, and propellers struts; rudders, external keels.

No damage.

(d) Details of impairment of keel structure.

No impairment to keel structure apparent to divers.

K. Tanks.

(a) Condition of tanks in areas of damage.

No apparent leakage due to test.

(b) Contamination of liquids.

No contamination of liquids due to bomb test (fresh water).

(c) Damage (known or suspected) to torpedo defense systems.

No damage to torpedo defense system (known or suspected).

L. Flooding.

(a) Description of major flooding areas.

No major flooding areas. Slight leakage in D-35-v and D-36-v.

(b) Sources of flooding.

Seepage from the sea probably through slight crack in seam or missing rivets.

(c) List of compartments believed to have flooded slowly so as to be susceptible to damage control.

No flooding.

M. Ventilation (exclusive of blowers).

(a) Damage to ventilation system and causes.

1. Ducts.

There was considerable damage to ducts above the third deck due to blast pressure and small amount of damage on the third deck and below in the machine shop and forward dynamc room.

2. Closures.

No damage to closures.

3. Effect on habitability.

No effect on habitability.

(b) Evidences that ventilation system conducted heat, blast, fire or smoke below decks.

In the area of the steam tables, evidence that fire and heat was conducted through the vent system. Pressure was conducted to vlower room forward of machine shop through the vent system and to the crews after head on the second deck.

(c) Evidences that ventilation system allowed progressive flooding.

No compartments flooded.

(d) Constructive criticism of design and construction of system.

Make vent ducts out of heavier plate where subject to blast.

N. Ship Control.

(a) Damage to ship control stations and causes.

1. Bridge area.

No damage.

2. C.I.C.

No damage, however, inoperative due to loss of all antennas.

3. Gyro compass equipment.

Repeater on open bridge 6° error, glass shattered. Stand for port alidade broken and bent over to a 45° angle.

4. Steering gear.

No damage.

5. Interior communications.

1 M.C. reproducer, 3 topside speakers broken by blast, wind direction and intensity transmitters blown overboard. All navigation light blown overboard or damaged beyond repair.

(b) Constructive criticism on ship control system.

It is suggested that better protection for topside remote control units and M. C. speakers be provided. Stands for peloruses should be made stronger.

O. Fire Control.

(a) Damage to fire control stations and causes.

1. Directors and elevated control positions, as previously stated, protected directors and control stations were intact. The damaged directors in Spot I and Spot II being only protected by light metal splinter shield and canvas received the direct effect of the blast. Spot I director was knocked out of line but suffered little other damage. The director in Spot II was knocked clear of the base and totally unserviceable, although the director itself can be repaired.

Control for the two 40mm twin mounts being exposed, suffered directly from blast and flying debris. Mk. 51 director #2 was damaged beyond immediate repair from falling debris from stack. Mk. 51 director for twin #3 is operable but Mk. 51 sight was damaged by blast. Alignment damage is unknown to present.

The four auxiliary director (Mk. 51 - 2) for the 5''/38 battery were undamaged but the two Mk. 15 sights for #3 and #4 were damaged due to blast.

2. All plotting rooms and protected spaces remained undamaged.

(b) List of stations having insufficient protection and estimated effect on fighting efficiency of the loss of each.

Station	Estimated Loss Fighting Efficiency of each.
AA Control Stations Air Forward Air Aft. 5'', 40mm, 20mm	65%
Spot I Main battery Spot II Main battery	40%

(c) Constructive criticism of location and arrangement of stations.

This is a difficult problem to solve, as control personnel manning such stations are required to pick up targets from all directions. However, it is necessary that some sort of enclosed protection for exposed personnel be devised to save them from the terrific flash burns. Perhaps some sort of non-shatterable glass or plastic could be used.

P. Ammunition Behavior.

(a) Ready service location protection, behavior under heat and blast.

Ammunition on this vessel suffered no damage from heat or blast. Daily visual examination of magazines samples has indicated no unusual effects on powder.

(b) Magazines, location, protection, forces involved, behavior.

Magazines location and protection proved effective and adequate for all types of explosions, even in ready service rooms and boxes which were scorched and deformed by the heat and blast, the ammunition remained uneffected.

(c) List of stowages whicha re insufficiently protected and effects on ship survival of explosion of each stowage.

None.

(d) Behavior of gasoline stowage facilities.

No gasoline on board.

Q. Ammunition Handling.

(a) Condition and operability of ammunition handling devices.

1. Main battery hoists remained intact and are operable.

2. Secondary battery hoists remained intact and are operable.

3. Passing scuttles show no indication of damage and remained operable.

(b) Evidences that any ammunition handling devices contributed to passing of heat, fire, blast or flooding water.

No evidence.

(c) Constructive criticism of design and construction of ammunition handling devices.

As there was no apparent damage, even to exposed scuttles, construction and design seem adequate and sufficient.

R. Strength.

(a) Permanent hog or sag.

No evidence.

(b) Shear strains in hull plating.

No evidence of any, whatsoever.

(c) Evidence of transverse or racking strains.

No racking strains due to blast pressure.

(d) Details of any local failures in way of structural discontinuities.

Hole in main deck frames 86 to 91 occured at location of machinery hatch soft patch. Overhead beam in Sick Bay at frame 50 broke on port side.

(e) Evidence of panel deflection under blast.

Port quarter of main deck aft, superstructure and starboard side of forecastle and second deck areas aft of armored deck.

(f) Turret, machinery and gun foundations.

Catapult foundation only one to fail.

S. Miscellaneous.

(a) Evidence of heat damage variations under various colors or camouflage painting.

Where white paint adjoined international orange, the orange burned. Where black adjoined orange, the black burned and the orange remained.

(b) Etc. Other miscellaneous effects or condition noted during inspection.

The entire interior of the ship covered with dirt and dust. Evidently blown out of the ventilation ducts. It was noted that none of the fire hoses on topside stations, even though surrounded by areas of badly scorched paint, was burned. 10" manila, the surface of the 10" manila lines were scorched black.

SECTION III

PART C - INSPECTION REPORT

SECTION B - MACHINERY

A. General Description of Machinery Damage.

(a) Overall condition.

Good.

(b) Areas of major damage.

Boilers, fireroom blowers and stack.

(c) Primary causes of damage in each area of major damage.

Blast effect and some fire damage.

(d) Effect of target test on overall operation of machinery plant.

No damage to put the Engineering Department out of commission except the rupture of the boiler casings.

B. Boilers.

(a) Air casings.

All boilers ruptured and distorted.

(b) External fittings.

No damage.

(c) Fuel oil burner assemblies.

25% of register flaps damaged reducing efficiency but not hindering operation.

(d) Brickwork and furnaces.

Small portion of brickwork knocked down, peak topping knocked down in all boilers. Estimate 4% brickwork damaged.

(e) Steam and water drums and headers.

No damage.

(f) Tubes (generating, superheater, downcomer, economizer).

No damage.

C. Blowers.

(a) Turbines and motors.

No damage.

(b) Blowers.

No damage to blower motors.

(c) Foundations.

No damage.

(d) External fittings, gages, etc.

One gage glass broken in total of twelve blowers.

(e) Shutters (air intake automatic, etc.).

All shutters jammed closed passed stops, requiring four man hours to repair each blower.

(f) Blower rooms (air lockers in enclosed firerooms).

No damage.

D. Fuel Oil Equipment.

(a) Heaters.

No damage.

(b) Strainers.

No damage.

(c) Manifolds.

No damage.

(d) Fittings.

No damage.

E. Boiler, Feedwater Equipment.

(a) Heaters.

No damage.

(b) Deaerating tanks.

Not applicable.

(c) Feedwater Tanks.

No damage.

(d) Miscellaneous.

No damage.

F. Main Turbines.

(a) Casings.

No damage.

(b) Bearings.

No damage.

(c) Rotors.

No damage.

(d) Blading and shrouding.

No damage.

(e) Packing and glands.

No damage.

(f) Valves.

No damage.

(g) Foundations.

No damage.

(h) Fittings.

No damage.

G. Reduction Gears.

(a) Foundations and casings.

No damage.

(b) Gears and shafting.

No damage.

(c) Bearings.

No damage.

(d) Couplings.

No damage.

(e) Fittings.

No damage.

(f) Turning gears.

No damage.

H. Shafting and Bearings.

(a) Shafting.

No damage.

(b) Bearings and bearing foundations.

No damage.

(c) Alignment.

No damage.

(d) Stern tubes, bulkhead packing glands, etc.

No damage.

External shafting not visually inspected. On test by operation, no unusual vibration or noises noted.

I. Lubrication System.

(a) Coolers.

No damage.

(b) Filters and strainers.

No damage.

(c) Purifiers.

No damage.

(d) Tanks (sump, settling, etc.).

No damage.

(e) Fittings (gauges, etc.).

No damage.

J. Condensers and Air Ejectors.

(a) Water boxes.

No damage.

(b) Shell and shell connections.

No damage.

(c) Expansion joints.

No damage.

(d) Air ejectors.

No damage.

(e) Inter and after condensers.

No damage.

(f) Miscellaneous valves, gages, fittings and attached piping.

No damage.

K. Pumps.

(a) Feed pumps.

No damage.

(b) Circulating pumps.

No damage.

(c) Condensate pumps.

No damage.

(d) Fire pumps.

No damage.

(e) Lube oil pumps.

No damage.

(f) Fuel oil pumps.

No damage.

(g) Other pumps.

No damage.

L. Auxiliary Generators (Turbine and gears).

(a) Foundations and misalignment.

No damage.

(b) Turbines.

No damage.

(c) Gears.

No damage.

(d) Coolers.

No damage.

(e) Governors.

No damage.

(f) Valves, fittings, etc.

No damage.

M. Propellers.

(a) Blades.

No damage.

(b) Caps, nuts, etc.

No visual inspection made on test of main engines, no unusual vibrations or noise noted.

N. Distilling Plant.

(a) Evaporators.

No damage.

(b) Distilling condensers.

No damage.

(c) Evaporator feed heaters.

No damage.

(d) Miscellaneous valves, fittings, gages, attached piping, etc.

No damage.

O. Refrigerating Plant.

(a) No damage to any part of the refrigerating plant.

P. Winches, Windlasses and Capstans.

(a) Foundations and bedplates.

Foundations slightly warped in all deck winches due to blast. Windlass foundations at forecastle deck level slightly out of line.

(b) Motors.

No damage.

(c) Brakes and brake lining.

No damage.

(d) Gearing.

No damage.

(e) Hydraulic systems.

No damage.

(f) Drums, bearings, shafting.

No damage.

(g) Fittings, wildcats, valves, etc.

No damage.

Due to sag in forecastle deck, shafting is slightly out of alignment causing couplings to creep in both anchor windlasses when hoisting in anchor. Coupling between main and forecastle deck.

Q. Steering Engine.

(a) Foundations.

No damage.

(b) Ram, quadrant, chains, screws, etc.

No damage.

(c) Hydraulic system, including pumps, piping, etc.

No damage.

(d) Follow up system.

No damage.

(e) Motors or engines.

No damage.

(f) Miscellaneous (steering stands, gages, etc.).

No damage.

R. Elevators, Ammunition Hoists, etc.

(a) Machinery foundations.

No comment.

(b) Motors and gearing.

No comment.

(c) Hydraulic systems.

No comment.

(d) Guide rails, dredger chains, etc.

No comment.

(e) Elevator platforms.

No comment.

(f) Brakes and brake lining.

No comment.

(g) Control systems and follow up gear.

No comment.

(h) Miscellaneous.

No elevators on board. All ammunition hoist on board operating satisfactorily.

S. Ventilation (Machinery).

(a) Fans and motors.

End bell broken on following motors; 2-119-2, 3-96-2, fans on blowers of the following vent sets frozen due to blower casing being distorted from blast damage. 02-79-2, 2-119-2, 3-96-2, 3-92-2, 3-83-4, and 3-83-2.

(b) Foundations and mountings.

Foundation on motor for vent set 2-122-1 broken through two legs. Motor for vent set 3-96-2 broken loose from deck.

(c) Heaters.

No damage.

(d) Miscellaneous.

No damage.

T. Air Compressors.

(a) Foundations.

No damage.

(b) Compressors and motors.

No damage.

(c) Coolers.

No damage.

(d) Tanks.

No damage.

(e) Miscellaneous gages, attached piping, etc.

No damage.

U. Diesels (Generators and Boats).

(a) Foundations.

No comment.

(b) Casings and cylinders.

No comment.

(c) Bearings, crankshafts, pistons, etc.

No comment.

(d) Fuel injection system.

No comment.

(e) Superchargers.

No comment.

(f) Governors.

No comment.

(g) Miscellaneous.

No boats were on board during the test. No damage was sustained in diesel generator and diesel fire pump equipment. All operating satisfactorily.

V. Piping.

(a) Main steam.

Main steam line in excellent condition with exception of three broken gage lines in following compartments, i.e. B-1-E, B-4-E, and B-5-E. Damage caused indirectly by blast effect due to casings blowing open on boilers and striking gage line.

(b) Auxiliary steam.

Slight leak in flange connections between compartment A-543-E and B-7-E. Not sufficient to disable auxiliary steam line. No other damage noted.

(c) Auxiliary exhaust.

No damage.

(d) Condensate and feedwater.

No damage.

(e) Fuel and feedwater.

No damage.

(f) Lube oil.

No damage.

(g) Firemain, sprinkling, and water curtain.

Firemain loop is in very good condition. Following risers damaged: Firemain riser aft of turret four, #2-116-1 broken off. Blanked off riser and fireplug 1-88-2 broken off. Salt water supply to spark arrester broken off in stack at boat deck level. Removed section of riser line to fire plug aft of stack on boat deck where broken. Riser to foam fire extinguishers in #5 fireroom cracked.

(h) Condenser circulating water.

No damage.

(i) Drain.

No damage.

(j) Compressed air.

No damage.

(k) Hydraulic.

No damage.

(l) Gasoline.

No damage.

(m) Other systems.

Fresh water system damaged in the following places: Captain's cabin. Filling fresh water line at frame 88 broken off. Fresh water line to scullery broken off. Fresh water line to Sick Bay broken off; Fresh water lines broken off main deck level frame 40. Fresh water line broken off in B-270-9L. Fresh water supply to scuttlebutts on third deck, frame 87 and frame 70 broken off.

Galley steam line broken in galley at frame 84 compartment B-0107-L.

Flushing systems: One section of flushing line. Ruptured D-206-L, One section of flushing line. Ruptured in A-210-L.

W. Miscellaneous.

Dishwasher damaged by blast in C-291-1L, all steam and water lines carried away, machine turned over on its side. Unrepairable, no damage would have resulted to personnel. Scuttlebut damaged beyond repair in C-291-1L, frame 90, midships.

SECTION III

PART C - INSPECTION REPORT

SECTION C - ELECTRICAL

A. General Description of Electrical Damage.

(a) Overall condition.

Overall condition of electrical equipment was fair.

(b) Areas of major damage.

Upper decks and superstructure in mainmast and foremast.

(c) Primary causes of damage in each area of major damage.

Superstructure damage caused by blast effect. Fire in Army equipment on boat deck caused damage to electrical cables in A-0114-L. 85% searchlight equipment destroyed by blast.

(d) Operability of electric plant.

Very good.

1. Ships service generator plant.

No damage.

2. Engine and boiler auxiliaries.

No damage.

3. Electrical propulsion.

Not applicable.

4. Communications.

Minor damage to one MC reproducer and one 21 MC speaker out of commission.

5. Fire control circuits.

Minor damage.

6. Ventilation.

Damage to 6 ventilation sets, considered minor.

7. Lighting.

Foremast and mainmast exposed lighting systems damaged. Lighting on the 01 deck damaged due to fire, considered very slight in the overall picture.

(e) Types of equipment most effected.

Cables and supports in areas exposed to the blast due to failure and distortion in the hull structure. Signal lights, navigational lights and fighting lights. Ventilation motors open to the blast through fittings not closeable.

B. Electric Propulsion Rotating Equipment.

Not applicable to this ship.

C. Electric Propulsion Control Equipment.

Not applicable to this ship.

D. Generators - Ships Service.

No damage.

E. Generators - Emergency.

(a) Frame and mounting.

No damage.

(b) Commutators or slip rings.

No damage.

(c) Brushes and brush rigging.

No damage.

(d) Bearings.

No damage.

(e) Fans.

No damage.

(f) Balance coils.

No damage.

F. Switchboards, distribution and transfer panels.

(a) Framework and mountings.

No damage.

(b) Electrical connections and wiring.

No damage.

(c) Busbars.

No damage.

(d) Circuit breakers, contactors, switches and relays.

No damage.

(e) Rheostats and resistors.

No damage.

(f) Mechanical Operating mechanisms and interlocks.

No damage.

(g) Insulating materials.

No damage.

(h) Instruments.

No damage.

(i) Rectifiers.

No damage.

(j) Fuses.

No damage.

(k) Voltage regulators.

No damage.

G. Wiring, Wiring Equipment and Wireways.

(a) Cable (power, lighting, I.C., F.C., propulsion and degaussing).

Cable damaged in area of bridge and superstructure due to distortion of hull structure. Cable damage in compartment A-0114-L caused by excessive heat generated from fire on boat deck directly above wireways.

(b) Wireway supports.

Those carried away due to failure of hull structure.

(c) Connection, junction boxes, receptacles and plugs.

Minor damages due to blast in superstructure area knocking covers off several boxes.

H. Transformers (lighting and I.C.).

(a) Framework and mountings.

No damage.

(b) Electrical connections.

No damage.

I. Submarine propelling batteries.

Not applicable.

J. Portable Batteries.

(a) Mounting.

No damage.

(b) Jars.

No damage.

(c) Cell and cable connections.

No damage.

(d) Acid spillage.

No damage.

K. Motors, Motor Generator Sets, and Motor Controllers (motor and controllers for engine room auxiliaries, steering gear, deck auxiliaries, air conditioning and refrigeration, ventilation, distilling equipment, etc. Motor Generator sets for lighting, welding, degaussing, battery charging, interior communications, etc.)

(a) Rotating Equipment.

1. Framework and mounting.

Minor damages.

2. Commutator or slip rings.

No damage.

3. Brushes and brush rigging.

Minor damage.

4. Bearings.

No damage.

5. Speed regulators.

No damage.

(b) Control equipment.

1. Framework and mounting.

Minor damage.

2. Electrical connections and wiring.

Minor damage.

3. Contactors, switches and relays.

No damage.

4. Rheostats and resistors.

Minor damage.

5. Insulating materials.

No damage.

6. Pilot circuit devices.

No damage.

7. Brakes.

No damage.

L. Lighting Equipment.

(a) Lamps (rough service, high impact and fluorescent).

Minor damage to all types in exposed areas due to ships structure failure. No damage to fluorescent lights in Captain's cabin.

(b) Reflectors.

No damage.

(c) Fixture mounts.

No damage.

(d) Shock mounts (U-strap type and plate type).

No damage.

(e) Pendant lamp holders.

No damage.

(f) Lamp gloves.

Minor damage due to blast in exposed area.

M. Searchlights (36'', 24'', 12'' and 8'').

(a) Framework and mountings.

Damage to all lights except to #1 24''.

(b) Front glass.

All glass reflectors broken except #2 and #3 12''.

(c) Shutter and operating mechanism.

All damaged except #2 and #3, 12''.

(d) Locks and brakes.

Completely broken on both 36'' and #2, 24''.

(e) Arc lamp feed rods.

All broken except #1, 24''.

(f) Incandescant lamps.

Completely broken except #3, 12''.

(g) Rheostats.

No damage.

N. Degaussing Equipment.

(a) Compass compensating coils and control boxes.

Magnesyn compass coils Spot II blown overboard.

Magnetic compass compensating coils on boat deck broken and distorted.

(b) Connection boxes.

Magnetic compass compensating coils connection box on superstructure deck blasted from hanger and adrift.

(c) Heading switches and relays.

No damage.

O. Gyro Compass Equipment.

(a) Master.

No damage.

(b) Repeaters.

One repeater on open bridge glass shattered and 6° out. The port pelorus stand broken at base.

(c) DRT and DRA.

No damage.

P. Sound Powered Telephones.

(a) Headsets.

No damage.

(b) Handsets.

Few damaged in exposed area.

(c) Jack and switch boxes.

Few smashed in exposed area.

(d) Stowage.

Few smashed in exposed area.

Q. Ships Service Telephones.

(a) Exchange.

No damage.

(b) Line equipment.

No damage.

R. Announcing System.

(a) Portable (PAM and PAB).

No damage.

(b) Amplifier racks.

No damage.

(c) Control racks.

No damage.

(d) Transmitting station.

No damage.

(e) Reproducers.

Three damaged in exposed area, all on port side of ship.

(f) Inter-Communicating Units.

One unit dislodged from mounting and broken, making it inoperative.

S. Telegraphs.

No damage.

T. Indicating System.

No damage.

U. I.C. and A.C.O. Switchboards.

No damage.

V. F.C. Switchboards.

No damage.

SECTION III

PART C - INSPECTION REPORT

SECTION D - ELECTRONICS

A. General Description of Electronics Damage.

(a) Overall condition.

The overall condition of transmitters, receivers and indicators is very good to excellent. All fire control and search radar antennas were damaged. The Mk. 28 was capable of being repaired. All others were totally destroyed.

(b) Areas of Major Damage.

Spot I (Mk. 28 SG and SK antennas) Spot II (Mk. 3 SG-2 and CPN Beacon antennas). Top of No. 1 and 4 Mk. 37 directors (Mk. 12 and Mk. 22 antennas).

(c) Primary cause of damage in each area.

Spot I, II and top of Sky 4 was blast. Damage to top of Sky I was primarily caused by falling debris from foretop.

(d) Operability of electronics equipment.

1. Radar.

All fire control and search radar were incapable of operation after the blast incident to damaged and destroyed antennas. The Mk. 28 main battery radar was subsequently repaired and is now back in service. The RCM equipment was severely damaged due to blast effect. Of the three RCM antennas, one was damaged (port signal bridge) and covers of other two were cracked but antenna remained serviceable.

2. Radio.

90% of the radio equipment was not damaged but 100% of the antennas were destroyed.

3. Sonar.

None aboard.

4. Loran.

The loran equipment was not operable upon return to the ship. The antenna was missing, a tube was broken and other minor damages were found. It took repair men about two days to locate all the trouble. The equipment is now operating.

(e) Types of equipment most effected.

Exposed antennas on all radars and RCM equipment.

B. Fire Control Radar.

Not damaged.

C. Surface Search Radar.

Not damaged.

D. Air Search Radar.

Not damaged.

E. Radar Repeaters.

Not damaged.

F. Radar Counter Measure Equipment.

Severely damaged.

G. Radar and Radio Beacons.

None on board.

H. IFF Equipment.

Items B through H all equipment is operable except that all antennas were destroyed and therefore, from a practical standpoint, all radars were not operative.

I. Communication Transmitters (Radio).

All operable.

J. Communication Receivers (Radio).

All operable.

Items I and J are operable except that all antennas were destroyed and therefore, from a practical standpoint, all radios were not operable.

K. Communication Antennas (Radio).

All damaged.

L. Radio Transceivers (combined transmitters and receivers).

Antennas out.

M. Sonar Echo Ranging and Listening Equipment.

None.

N. Sonar Echo Sounding Equipment and Altimeters.

Operable.

O. Loran Navigation Equipment.

See Item A, (d) 4.

P. Power Supplies (Motor Generators and Filters).

None damaged.

Q. Television and Teletype Equipment.

None on board.

R. Test Equipment (including frequency meters).

All in good operable condition.

S. Instrumentation.

None on board.

T. Telephone Equipment.

No damage.

U. Direction Finders (Radio).

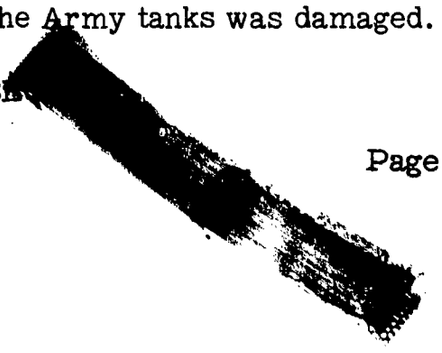
None on board.

V. Spare Parts.

No damage.

W. Army Electronics.

Ninety-five percent of the Army electronics equipment received minor damage such as broken tubes, blown capacitors, sheared mounting, brackets and visual outside scorching. These items could be easily repaired from spare parts. However, all Army Signal Corps equipment was located on the starboard side of the fore castle and was protected by #2 turret from the scorching and blast effects of the bomb. None of the electronic equipment in the Army tanks was damaged.



Defense Special Weapons Agency
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TRC

10 April 1997

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTENTION: OMI/Mr. William Bush

SUBJECT: Declassification of Reports

The Defense Special Weapons Agency (formerly Defense Nuclear Agency) Security Office has reviewed and declassified the following reports:

AD-366718	XRD-32-Volume 3
AD-366726	XRD-12-Volume 2
AD-366703	XRD-16-Volume 1
AD-366702	XRD-14-Volume 2
AD-376819L	XRD-17-Volume 2
AD-366704	XRD-18
AD-367451	XRD-19-Volume 1
AD-366705	XRD-20-Volume 2
AD-376028L	XRD-4
AD-366694	XRD-1
AD-473912	XRD-193
AD-473891	XRD-171
AD-473899	XRD-163
AD-473887	XRD-166
AD-473888	XRD-167
AD-473889	XRD-168

AD-366705

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SUBJECT: Declassification of Reports

AD-B197749	XRD-174
AD-473905	XRD-182
AD-366719	XRD-33 Volume 4
AD-366700	XRD-10
AD-366712	XRD-25 Volume 1
AD-376827L	XRD-75
AD-366756	XRD-73
AD-366757	XRD-74
AD-366755	XRD-72
AD-366754	XRD-71
AD-366710	XRD-23 Volume 1
AD-366711	XRD-24 Volume 2
AD-366753	XRD-70
AD-366749	XRD-66
AD-366701	XRD-11
AD-366745	XRD-62.

All of the cited reports are now **approved for public release; distribution statement "A" applies.**

Ardith Jarrett

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